

STRATHPEFFER SPA

ITS WATERS
AND
CLIMATE

R. FORTESCUE FOX

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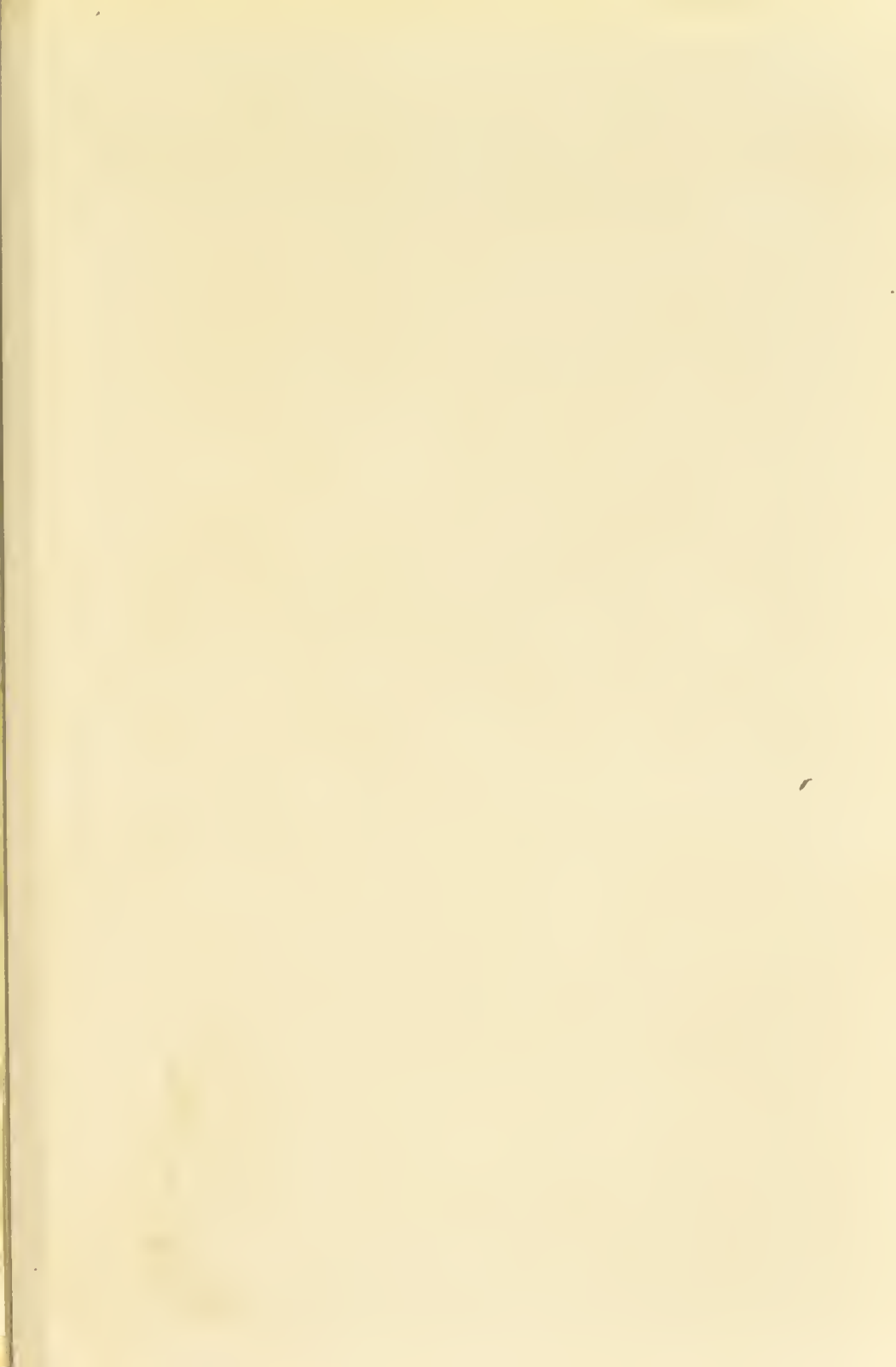
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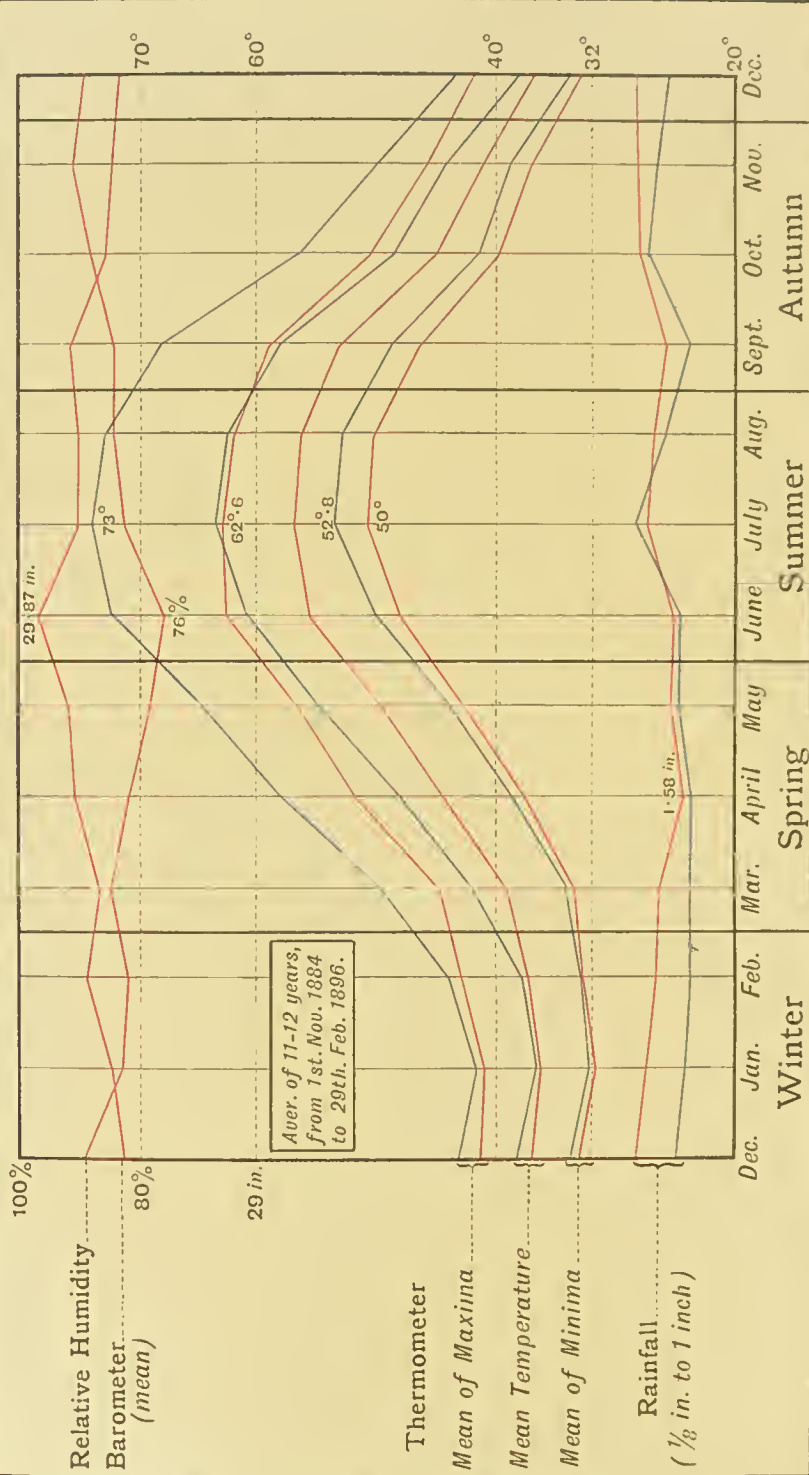


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Meteorology of Strathpeffer Spa (red), compared with Royal Observatory Greenwich (blue).



STRATHPEFFER SPA

ITS

WATERS AND CLIMATE

BY

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THIRD EDITION



THE 'EAGLESTONE'

LONDON

ADAM AND CHARLES BLACK

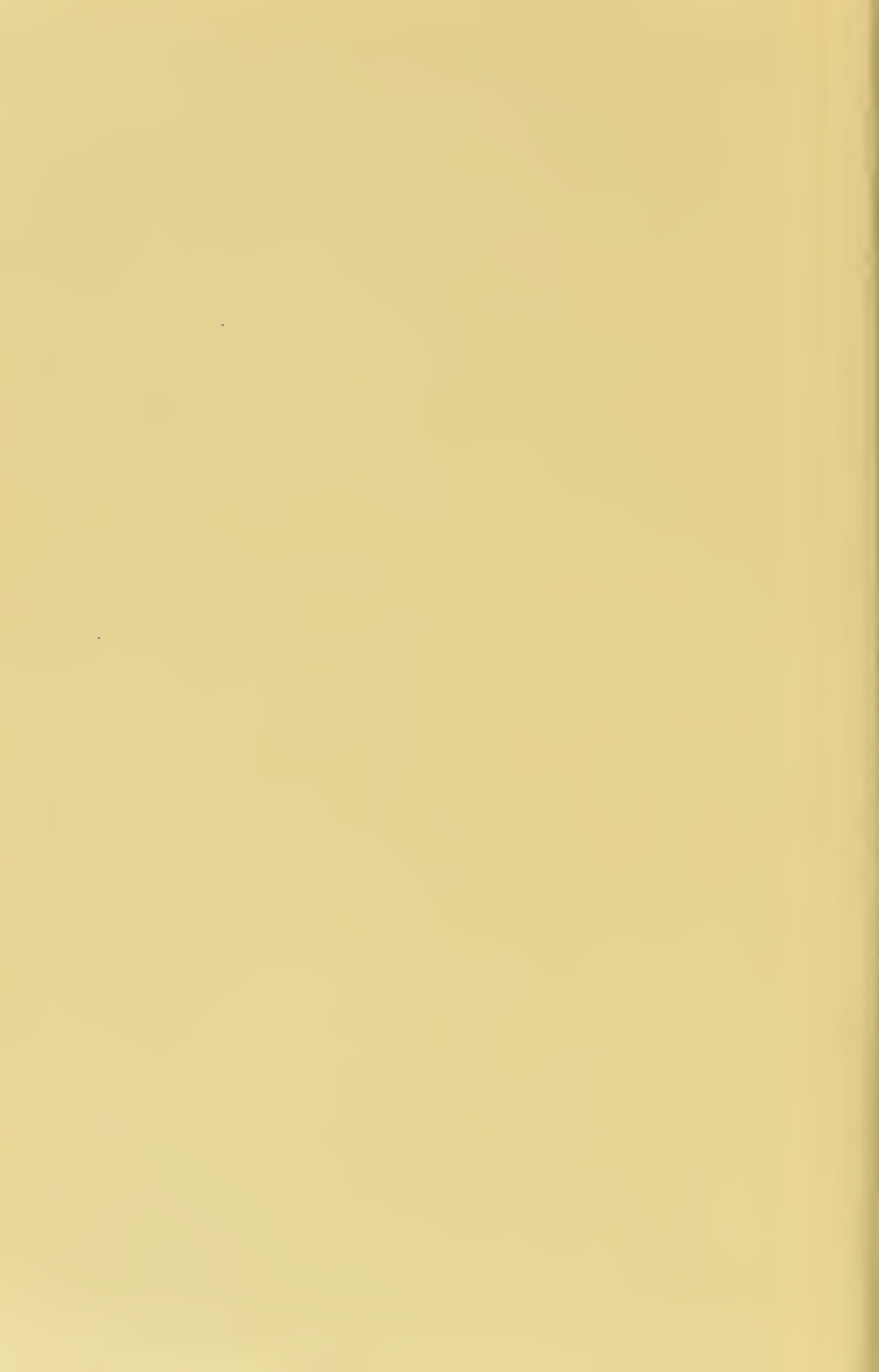
1896

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TO THE
Members of the Medical Profession
IN
ENGLAND, SCOTLAND, AND IRELAND
THIS TREATISE
ON THE MOST NORTHERN OF THE BRITISH SPAS
IS RESPECTFULLY DEDICATED
BY
THE AUTHOR

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PREFACE

THE nine years that have elapsed since the first edition of this little work was published have witnessed many changes at Strathpeffer Spa, as elsewhere. During the same period the Spas and Health Resorts of Great Britain have, most of them, undergone a considerable, and an accelerating, development, with a view to meeting, in different ways, the varied needs of the health-seeker.

I think that there is also, both in medical opinion and in the public mind, every year a greater willingness to believe that Mineral Waters and Climate, with the associated influences of Spa life, unite to form the best mode of treatment for a large number of chronic ailments. Many of

these ailments arise from the habits of modern civilised life and the increased nerve tension of our time. Some antidote is required for these inevitable ills. In what place can it be more surely found than at some Health Resort, where for a few weeks in every year we can substitute for these artificial habits a simple, healthy, out-of-doors life, or relieve the tension of an overwrought nervous system by the various means which a well-appointed Spa provides ?

At Strathpeffer Spa the *armamentarium* has been greatly developed and extended during the last few years; and it has therefore become necessary to introduce into the present edition much new matter, particularly in the sections devoted to the Waters and Baths.

The discovery of a Sulphur Water stronger than the so-called "Strong" Well at Strathpeffer has necessitated a new name for the older spring, and, on the suggestion of my friend Dr. Bruce, this water has been re-named the *Morrison* Well, after the man who in a former generation first

brought the virtues of the Waters of Strathpeffer to the notice of the medical profession.

A recent complete analysis of the Lady Cromartie Spring, and a series of estimations of the other sources, spread over several years, have enabled me to deal more fully than heretofore with the Chemical properties of the Sulphur Waters. A new and exhaustive analysis of several of the wells is, however, still greatly to be desired.

The chapters dealing with the therapeutics of Mineral Waters in general, and with the medicinal properties of the Sulphur Waters, have been in large part re-written, and the indications and contra-indications stated in greater detail. The employment of Sulphur Waters in affections of the respiratory passages, by *pulverisation* and *inhalation*, was first attempted at Strathpeffer Spa in 1889. Subsequent experience tends to confirm the favourable opinion of this treatment held at the French Spas, and when adequate apparatus is provided it will no doubt be extensively employed in this country.

Two special forms of Thermal Treatment have been recently introduced at Strathpeffer, and are described in Chapter VI., viz. the *Low Pressure Douche* and the *Peat or Moor Bath*. The proper science of baths and other thermal applications has yet to be built up by exact observation and experiment; and in this treatise I have only attempted to define as far as possible the therapeutic range of the treatment employed at Strathpeffer. Experience has shown that the *ill* effects of baths wrongly used may be as unmistakable as the *good* that results from their right employment in appropriate cases. Their routine use as a fixed "cure" is therefore not only futile, but often disastrous.

The account in Chapter VIII. of the Climate of Strathpeffer Spa is based on a series of meteorological observations which now extend over more than eleven years. The various elements have been carefully analysed, and compared with the records of the Royal Observatory at Greenwich for the same period. Some account of the

meteorology of the *season months* has been introduced in the preceding chapter.

My best acknowledgments are due to the following gentlemen, either for valued corrections in the text, or for placing meteorological data at my disposal: James Aitken, Esq., of Braemar; Alexander Buchan, Esq., of Edinburgh; Dr. Colborne of St. Leonards; Rev. Dr. Joass of Golspie; Edward Kitto, Esq., of Falmouth; and G. J. Symons, Esq., of the Royal Meteorological Society.

EAGLESTONE, *May* 1896.

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ERRATUM

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STRATHPEFFER SPA

ITS WATERS & CLIMATE

CHAPTER I

HISTORICAL SKETCH

SITUATED in the Highlands of Scotland, nearly twenty miles north-westward by rail from Inverness, is a broad valley between four and five miles in length. At its eastern extremity it opens on the sea-coast at Dingwall. It is sheltered on the north by the broad shoulders of Ben Wyvis (3429 feet); the more rugged and broken mountains of Ross-shire enclose the western end; whilst to the south the vale is bounded by the narrow ridge named, from its bristly contour, Druim Chat, "The Cat's Back."

This is Strathpeffer—the Strath of the Peffery

—a green and fertile valley on the eastern verge of a wild and rocky hill country. A cluster of gray stone houses nestles at its upper end, and this is Strathpeffer Spa, the subject of the present pages.

From the hills above it the eye ranges over the Black Isle and Cromarty Firth to the eastward, and to the west over a mountainous country broken by water-courses and interspersed with lochs. Once the scene of perpetual feuds, this country is now for the most part devoted to the peaceable pursuit of sport. Grouse moors and deer forests stretch for miles over the silent hills, and the angler has taken possession of every stream. In Strathpeffer, the vale below, the change is still more striking; for the very spot where sanguinary clan conflicts have been fought again and again has become, in a milder age, a Place of Healing.

Although in most cases Mineral Springs have been resorted to from early times, at all events by the sick of the vicinity, there is no record of any considerable use of the Strathpeffer waters much before the beginning of the present century.

Hints are forthcoming of an earlier local fame, but what appears to be the first published account of the "Castle Leod Water" was communicated to the Royal Society in London in 1772, by Dr. Donald Munro, F.R.S.¹ "Having heard many gentlemen from the county of Ross speak of these waters," Dr. Munro asked for an account of them from "some physical person" in the neighbourhood.

Dr. Alexander Mackenzie of Tarbet forwarded him a description, in which he remarks: "The Castle Leod is a strong sulphureous mineral water. When taken up from the spring it is as pure and transparent as the clearest rock water, but if kept in an open vessel or an ill-corked bottle it soon becomes of a milky sort of foulness, and it loses its strong sulphureous smell in twenty-four hours. The bottom of the well, and of the channel which conveys its water from thence, are black, as if dyed with ink; and the leaves of the alder bushes that fall into the well soon contract a blackish colour; . . . but when taken out and dried appear covered with a whitish dust, which is undoubtedly sulphur, burning with a blue flame.

¹ *Philosophical Trans.* vol. lxii. p. 15.

All that I can learn of the operation of this water from some sensible people of credit and observation, who have drunk it this as well as former seasons, is, that it very sensibly increases the action of the kidneys, and sometimes remarkably opens the pores ; but I do not find from the report of any that it purges, though drunk to the quantity of three, sometimes of four, English quarts in the day. Almost every person remarks that it whets the appetite, and sits light on the stomach. . . . Every person in the country prescribes the water for themselves, and runs to the well or sends for the water for every complaint, acute and chronic." By others Dr. Munro was informed that the waters had "been used with success in many of those cutaneous disorders commonly called scorbutic, and in curing the itch."

Experiments were presently made upon some samples of the water that had been sent to London. "A shilling and a sixpence put into two different teacups were presently tarnished, and became of a very dark colour. A watery tincture of galls brought a variegated scum of the colour of a pigeon's breast to the surface." The water was

evaporated in large stone basins, and the sediments, which were small, very carefully tested. Dr. Munro found a soluble black earth, an insoluble earth, possibly selenite, a crystalline salt apparently identical with Glauber salt, and a "small pittance" of a yellow oily matter containing a perceptible proportion of sulphur. He adds: "It appears that this is one of the strongest sulphureous waters hitherto found in Great Britain. . . . In its natural state it is impregnated with a volatile sulphureous vapour, which evaporates soon when exposed to the open air, and flies off immediately when exposed to heat. The water then loses its strong sulphureous smell and taste."

Five years after this was written, in consequence of the demand made upon the waters, some sort of accommodation for visitors became absolutely necessary. At that time the Estates of Cromartie, including Strathpeffer, were, with many others affected by the late rebellion, still in the hands of the Crown. The Factor of Cromartie was then (1777) a Mr. Colin Mackenzie, a man who holds an honourable place as pioneer in the development of the Spa. As a result of his energetic repre-

sentations¹ the Commissioners of the Forfeited Estates directed further investigations to be made and a report prepared. It was then discovered from geological examination that water-bearing strata occurred in different parts of the valley, and that there were not one but several powerful springs of Chalybeate and Sulphur Water.

Having in this manner been brought into notice as a Spa, Strathpeffer attracted the attention of medical men and others both in England and Scotland. But travelling was then slow and difficult. Comparatively few southerners could venture into Scotland for mineral waters; and Strathpeffer thus became and remained the Spa of the northern counties, from the west coast, Lewis and the far north to Aberdeenshire in the east. "Great numbers," says a local writer in 1791, "from the counties of Inverness and Sutherland, and the western districts of Ross-shire, have resorted hither."

Twenty years later, while the sulphur waters flowed as before, the stream of popular favour

¹ See Appendix: "The Memorial and Representation of Colin Mackenzie."

appears to have suffered a temporary check, for Sir George Mackenzie, the philosophic proprietor of Coul, writes (1810): "The once-famed virtues of the Strathpeffer Spring *are beginning to be neglected*. It has been celebrated for curing all sorts of diseases, particularly scrofula and diseases of the skin."

To Doctor Thomas Morrison, of Elsieck and Disblair in Aberdeenshire, belongs the credit of again bringing Strathpeffer into the light of day, and establishing it in its rightful position as one of the acknowledged Health Resorts of the country. Acting on the old precept, *Physician heal thyself*, Dr. Morrison first found in his own case, after the trial of many remedies, a complete cure from the use of these waters. Encouraged by this, and by many other examples of successful treatment, he lost no time in making the virtues of Strathpeffer known. He came to live near the Spa, at Elsieck Cottage, and exerted himself to raise a small Pump Room over the "Strong Well" in 1819, on the site of the present building. There his portrait, by George Watson of Edinburgh, may still be seen, and there are residents yet living who remember

the antique dress and dignified bearing of the old Doctor.

Even after Dr. Morrison's time, however, the Spa long remained very deficient in necessary accommodation. A recent visitor thus in his old age graphically describes his own experience between 1830 and 1840 : "I had heard of Strathpeffer, and I wanted to see what sort of a place it was. Riding out from Dingwall, I do not think I could find a feed for my horse or for myself, and I had to ride back again without."

All this was soon to be changed. In 1861 a strong stone Pump Room took the place of the old wooden building ; a second story with new bath-rooms was added in 1871, and ten years later the range now known as the "Ladies' Baths" was erected. In the meanwhile, the successive extensions of the railway northward, to Inverness, to Dingwall, and finally, by the branch line opened in 1885, to Strathpeffer itself, made it more accessible to the English invalid. Not only so, but they placed it in touch with the South ; and so have brought, and are still bringing about, that more perfect development of the resources of the

Spa, which alone—and rightly so—can enable it to satisfy present-day requirements.

The above is but a faint outline of the history of Strathpeffer; but it exhibits the familiar features of slow beginning, varying fortunes, and, under more favourable circumstances, rapid growth. Moreover, in the case of Strathpeffer, the progressive movement of the last decade perhaps exceeds the accumulated advance of the preceding century. To Thomas Morrison and Colin Mackenzie will always belong the honourable distinction attaching to the founders of the Spa; but one more recent name is entitled to rank with theirs, that of the late Dr. David Manson. He was the first (in 1866) to publish a systematic treatise on the Spa, and to him is directly or indirectly due the benefit which thousands have derived from its waters.

Among the more recent additions and improvements at Strathpeffer Spa the following may be named: the erection of *Douche Baths* similar to those of Aix-les-Bains, and fitted with the apparatus necessary for this valuable treatment; some improvements in the *storage of the Mineral Water*

and in the *methods of heating* it, without deterioration and without dilution, both for drinking and for baths; the discovery of a new and strong source of Sulphur Water (the *Lady Cromartie Spring*) and its analysis¹; the introduction of apparatus for *Pulverisation* and *Inhalation* (as at Marlioz and elsewhere), by means of which the action of the sulphur water may be obtained upon the throat and air-passages; the use of *Pine Baths*; the erection in 1889 and 1896 of buildings for *Peat* or *Moor Baths*, with all their varied appliances and accompaniments. Strathpeffer Spa, from its situation in a region of moorland and peat moss, is fitted, better perhaps than any other British Spa, to the supply of these baths. They are essentially a special mode of thermal treatment, and although new in this country, have been long valued on the Continent of Europe.

Lastly, there is the *Mineral Waters Hospital* for poor invalids, built in 1895-96, by means of a bequest from the late Mrs. Morison Duncan, with the generous aid of visitors to Strathpeffer. This institution is from one point of view of more

¹ See Chapter II.

consequence than any other improvement, for it will do something to enable Strathpeffer to fulfil one of the obligations that attach to all Health Resorts, namely, to bring within the reach of the poor the benefits they confer.

The impulse of development which in the last quarter of the present century has spread like a wave over the Mineral Spas of this country, was nowhere more powerfully felt than at Strathpeffer. The visitations of cholera on the Continent, and, at the same time, the increased willingness on other grounds of the medical profession and of the public to acknowledge the forgotten merits of the Home Spas, were no doubt among the chief causes of this movement. They afforded at the same time the best justification of an earnest endeavour, not only to extend and perfect, in all the methods approved by science, the precise administration of our Baths and Waters, but also to make the Health Resorts, in a manner unknown before, pleasant and attractive to invalids of all classes.

CHAPTER II

THE CHEMICAL PROPERTIES OF THE SULPHUR WATERS

THE Sulphur Springs of Strathpeffer belong to the class of *Cold Sulphur Waters*, a class particularly well represented in Great Britain; and among others by Harrogate in England, Llandrindod and Llanwrtyd in Wales, Lisdunvarna and Lucan in Ireland, and by Moffat in the south and Strathpeffer in the north of Scotland. Chalybeates, by a happy circumstance, are very apt to occur in the neighbourhood of such springs, and Strathpeffer makes no exception to the rule. On the Continent of Europe, in addition to the cold sulphur, there are numerous warm, or *Thermal, Sulphur Waters*, but these, as we shall presently see, are for the most part very weak in the sulphur elements.

In this large class of waters, whether warm or cold, the element sulphur exists in two chief forms. In the larger number of cases it is chemically united with hydrogen gas, forming the well-known compound *hydric sulphide*, or Sulphuretted Hydrogen—the gas which gives to such waters not only their peculiar taste and odour, but also much of their efficacy. A second combination of sulphur is with metals, as *alkaline sulphides* or sulphydrates. In the Strathpeffer Springs, sulphur occurs in both forms, and in such degree as to give them a very high position among British Sulphur Waters.

The minute comparison of different mineral waters of the same class, although interesting, is a matter of no little difficulty, and scarcely perhaps of commensurate importance. The chances of error are numerous. In the first place, the analyses are made by different chemists. They are separated in point of time by many years, and follow therefore, in all probability, different methods of determination. They are furthermore subject to important differences arising from the *season* of the year and the *place* in which the examinations were made, not forgetting the important question

whether it was an analysis of *fresh* water made at the source, or of *bottled* water examined after a variable interval in a laboratory at a distance. These circumstances in many instances render extremely difficult a just comparison of different waters, more particularly in cases where unstable salts or volatile gases are concerned.

An example of the uncertainties attending these comparisons may be found in the manual of the late Dr. Manson.¹ Dr. Manson, with the published analyses before him, sought to compare the Strong Well at Strathpeffer with the strongest waters of Harrogate. For the contents of the former he had the high authority of Dr. Murray Thomson (1857); for those of Harrogate that of Professor Hoffman (1853). From the analyses of these chemists it followed that the Scottish water contained *sulphuretted hydrogen* (hydric sulphide) in more than twice the quantity found at Harrogate, although falling considerably short of Harrogate in *alkaline sulphides*. So matters stood until 1875, when Dr. Thorpe showed, by a more perfect method, that the "Old Sulphur" spring at the English Spa was

¹ *Strathpeffer Spa*, 5th ed., p. 12.

considerably richer in the hydric sulphide than had been supposed by former analysts; that in fact it approached, in this respect, much more nearly to the Strong Well of Strathpeffer, having, on Dr. Thorpe's showing, 10·16 cubic inches of this gas to the gallon, as compared with 11·26 cubic inches (Thomson) at the latter place. Further, as respects alkaline sulphides, the *new analysis* continued to show for the Harrogate water a superiority over the *old analysis* at the sister Spa, although, once more, not to the extent that had been supposed. It may be permitted to doubt whether the comparison has reached its final stage, even yet; but, in the meantime, it remains true, in Dr. Manson's words, that the "Strathpeffer Strong Well (now called the *Morrison* Well) contains the largest quantity of sulphuretted hydrogen in any known spring in Great Britain,"¹ whilst, so far, the palm for the alkaline (sodium) combination of sulphur remains, among British Spas, with Harrogate. It is not, however, wonderful that in waters containing large quantities of salt (chloride of sodium), as at

¹ Excepting only the new "Cromartie Well," concerning which *vide infra*.

Harrogate, the sulphide of the same metal should be found more abundantly than in waters almost devoid of this salt. As regards the hydric sulphide, in which the Strathpeffer Springs are by common consent pre-eminently rich, much larger proportions than those quoted above have been noted by competent observers at Strathpeffer, particularly in the colder months of the year.

After all, the main object of an analysis is a practical one. It is to furnish to medical science an exact knowledge of the active constituents of a water, their chemical condition and relations. The knowledge of their exact proportions in comparison with other Spas is of secondary consequence. At the same time, to show that English, Scotch, or Irish mineral waters are many of them equal in their essential chemical and medicinal properties to the much-praised springs of France and Germany, may be regarded as a service not only to truth but to country.

In the numerous analyses of the Continental waters belonging to this class, the *sulphur element* is sometimes given as cubic inches of the gas, and sometimes as grains per gallon of sulphides, or of

the element sulphur itself. As we shall afterwards have occasion to note, no valid distinction can, for medicinal purposes, be drawn between the gaseous (hydric) and the alkaline (sodium) sulphide; or, if there be any, it would seem to be in favour of the more volatile compound. The two forms of sulphide may therefore, for practical purposes, be considered as one. In the following table the author has grouped some of the more important Continental sulphur springs, both cold and thermal. The figures represent the total weight both of sulphuretted hydrogen and of alkaline sulphides in grains per gallon.¹

COMBINED ALKALINE AND HYDRIC SULPHIDE

(1) Cold Sulphur Waters—		Grains per gallon.
[Strathpeffer (Morrison Well)	.	6·17]
Eillsen . . . . .	.	6·03
Nenndorf . . . . .	.	4·53
Weilbach . . . . .	.	0·61
(2) Thermal Sulphur Waters—		
Luchon . . . . .	.	3·90
Barèges . . . . .	.	3·60

¹ The results are calculated on a careful comparison of various published analyses. See *Curative Effects of Baths and Waters*, Dr. Braun; *Baths and Wells of Europe*, J. Macpherson, M.D.; *Watering Places of Germany*, Dr. Gutmann; *Harrogate and its Waters*, Geo. Oliver, M.D.; *Mineral Waters of Aix-les-Bains*, Dr. Blanc; *La Medication de Challes*, Dr. Royet; etc.

Aix-la-Chapelle	2.65
Cauterets	2.10
St. Sauveur	1.47
Aix-les-Bains	0.57
Eaux Bonnes	0.57
Eaux Chaudes	0.50

As a class the Cold Sulphur Waters are far stronger than the Thermal or Warm Waters, an observation which agrees with the familiar effect of heat in dissipating and breaking up the combination of sulphides. The famous Pyrenean waters, Luchon and Barèges, are *for thermals* uncommonly rich in these ingredients, the former containing nearly two-thirds the proportion of the Morrison Well at the Scottish Spa.

Four sulphur waters are at present drunk at Strathpeffer. Of these, the *Morrison Well*¹ and the *Castle Leod Well*² rise directly under the Pump Room floor, from fissures in the slaty rock, whilst the *Upper Well* has been conveyed thither through ebonite tubes from its source on a higher level one hundred yards distant. These waters have been repeatedly examined by experts. The

¹ Formerly called the "Strong" or "New Well."

² The "Castle Leod Water" was the earliest discovered of the sulphur springs at Strathpeffer, and has been for many years known as the "Old Well."

following table is compiled from the latest analyses of these three springs, made in 1857 by Dr. Murray Thomson of Edinburgh :—

SYNOPSIS OF ANALYSIS OF 1857—IN IMPERIAL GALLON ¹

	Morrison Well.	Castle Lead Well.	Upper Well.
I. SOLIDS.	Grains.	Grains.	Grains.
Sulphate of Lime . . .	50·92	18·89	23·43
Carbonate of Lime . . .	14·88	7·43	6·24
Phosphate of Lime and Magnesia . . .	0·50	0·43	...
Sulphate of Magnesia . . .	31·08	...	39·18
Carbonate of Magnesia . . .	traces	1·09	1·78
Sulphate of Soda . . .	5·86	2·47	9·87
Sulphuret of Sodium . . .	0·53	0·78	0·12
Sulphuret of Potassium . . .	1·30	...	0·89
Silica	2·14	0·77	3·06
Organic Matters	1·02	2·66	2·35
Sulphur in suspension . . .	4·07	2·47	1·84
Chlorine	traces	...	...
Chloride of Sodium . . .	...	4·60	4·54
Potass Salts . . . . .	...	traces	...
Sulphide of Iron . . . . .	...	...	1·08
	112·30	41·59	94·38
II. GASES.			
Sulphuretted Hydrogen . . .	4·34	1·60	1·21
The same in cubic inches . . .	11·26	4·01	3·03
Carbonic Acid—undetermined			

¹ Equal to 160 fluid ounces ; 70,000 grains in weight ; and 277 cubic inches by volume.

THE MORRISON WELL (No. 3)

In respect to the Morrison Well, Dr. Thomson remarks :—

“The water had no action on either red or blue litmus papèr exposed to its action for more than an hour. When a delicate thermometer was plunged into the cistern, and allowed to remain ten minutes, it showed a temperature of 55° Fahr., the temperature of the atmosphere at the same time being 59°.

“The amount of sulphuretted hydrogen was twice determined in September 1857, and once again in September 1859. On these trials the quantities given were respectively 4·48, 4·64, and 4·00 grains of this gas in a gallon. The mean of these numbers is 4·34, which, converted into cubic inches, gives 11·26 as the volume of sulphuretted hydrogen in an imperial gallon. The qualitative analysis showed the presence of—Base: lime, magnesia, potass, soda, trace of iron. Acids: sulphuric, carbonic, phosphoric, hydrosulphuric, silicic; and sulphur. Besides these there was present a very small amount of organic matter. The specific gravity of the water at 60° is 1002·46.

I may also add that this water can retain for a long time a good deal of its sulphuretted hydrogen gas. A sealed bottle opened twenty days after my visit to Strathpeffer contained this gas in quantity at the rate of 2·08 grains in a gallon, or nearly one-half of what it had at the Well."

The relatively large amount of lime salts in this spring—a little more than three grains to the pint—is an important fact, which affects the medicinal uses of the water. Expressed otherwise, the *hardness* of the Morrison Well is 58°, whilst that of the Upper Well is only 16°.¹

Although the gaseous constituents of a mineral water are apt to vary from time to time, the Morrison Well preserves a remarkable constancy. It has been suspected for many years that the water was stronger in winter, and two observations are recorded by Dr. Manson showing that in the winter of 1882-83 there was considerably more sulphur present in this water than appears from the figures of the analysis of 1857. He found on

¹ This was estimated for the author by Mr. T. Wellwood Maxwell, whose valuable analytical work is frequently referred to in this chapter. His work forms a good beginning in the determination of the chemistry of the Strathpeffer waters.

7th November 16·1 cubic inches per gallon of sulphur gas, and on 26th April as much as 22·7 cubic inches, which is exactly twice the amount shown in Dr. Murray Thomson's analysis.

Systematic observations of this well were commenced by us in 1891. A suitable float was fitted to the water to prevent deterioration by exposure to the air, and all samples were drawn with care from a certain depth below the surface. The amount of sulphur present, as sulphide or sulphuretted hydrogen, was accurately determined by Mr. Maxwell. Thirty-five consecutive determinations, taken at all seasons and spread over a period of three years, give an average of 6·48 grains of *sulphur* per gallon. The highest observed strength was on 10th February 1892 (7·8 grains), and the lowest 13th September 1894 (5·0 grains).

Is it possible that the season of the year, or that variations of rainfall or temperature can have any effect on the waters? In order to elucidate this question regular monthly estimations of the sulphur of the principal springs were made, extending over several years. The resulting figures were then represented in a diagrammatic form and com-

pared with the rainfall and mean temperature of the several months. From this investigation it was proved that fluctuations in the *rainfall* have no influence on the strength of the Morrison Well, which rises and declines without any relation to wet and dry periods. The influence of *temperature* is, however, very striking. Not only is the water always stronger in the colder months of the year (October to March), but slight falls of temperature at any period of the year are accompanied by increased strength of the water. For example, in 1894 the month of May was slightly colder than April. There was in May a corresponding rise in sulphur. In July the weather was very warm and there was a heavy fall in sulphur. August was decidedly colder, and now the sulphur curve rises rapidly. Lastly, September was a warm month, and the proportion of sulphur correspondingly declined. With regard to *rainfall*: in the month of July, when sulphur was low, there were four inches of rain, but hardly any rain fell in September. It should be added that if the source is suitably protected, and the water is served in a proper manner, these fluctuations will be confined

within narrow limits, and are not therefore of practical consequence. It is, however, obvious that waters of this kind are extremely sensitive to external conditions. Exposure, even for a short time, in an unprotected cistern, and the slight agitation produced by the operation of pumping, lead to appreciable deterioration. Hence the great advantage of a service *fed by gravitation from the source*, a principle which has been already applied to the service of the Cromartie Well.

The high "winter charge" of sulphur in the Morrison Well often continues without much abatement until the month of June. Hence it is obvious that the winter is the best time for the exportation of the water ; and that for the treatment of cases (for example, certain skin affections) in which especially powerful baths and waters are required, the earlier months of the season, May and June, or the month of October, ought to be chosen.

THE UPPER WELL (No. 2)

This valuable water rises about one hundred yards from the Pump Room, and in the memory of persons still living was served to invalids in

the most primitive fashion by dipping jugs and cups at the source. It at present runs into the Pump Room ; but in order to obtain the water in the best possible condition, it has been proposed to take advantage of the principle of gravitation, already referred to, and deliver this, with all the other sulphur waters, at a lower point in the valley. The Upper Well has been examined by different observers, and large quantities of sulphur have been recorded. The late Dr. Thompson of Glasgow found on one occasion 26 inches of sulphur gas per gallon. In 1860 samples of the water were sent to London and analysed by Dr. Medlock. He found 9 cubic inches, and expressed the opinion that the quantity would be found very much larger "if the gas analysis were made on the spot." When the late Dr. Manson examined the water at the source in April 1883, he reported as much as 27·1 cubic inches.

The Upper Well differs in an important manner from the other sulphur wells in the character of its solids. The salts of lime are much *less* in quantity, and the salts of magnesia and soda *more* than in the Morrison Well. There is also in the Upper Well a certain amount of chloride of sodium,

which is absent from the Morrison Well, although present in the Castle Leod Spring. The *hardness* of the water is stated as 16° ; the Morrison Well being 58° . It follows that the medicinal properties of the two waters are by no means identical, a fact which the practical administration of the water abundantly confirms.

THE CASTLE LEOD SPRING (No. 1)

This is the original "Castle Leod Water," by means of which in the last century Strathpeffer first acquired name and fame as a Spa. It is a water of considerable value, although the discovery of new and more powerful springs during the present century has for the time placed its light under eclipse. Monthly observations, extending over three years, show an average *sulphur* charge of 2 grains per gallon, which is somewhat increased since the water was served by a gravitation process. The maximum reading is 3 grains (31st March 1894), whilst the figures of 1857 show only 1.83 grains.¹

¹ Dr. Murray Thomson's results are now nearly forty years old, and it is full time they were supplemented by a new and

The Castle Leod Water, so far as can be judged from the imperfect examinations that have hitherto been made, may be regarded as a pure sulphur water of fairly constant strength, amply sufficient for many conditions in which sulphur waters are employed. It is of a low degree of hardness, and is readily digestible. It contains a small quantity of chloride of sodium, although rising from the rock about six feet from the Morrison Well, which contains none.

THE LADY CROMARTIE SPRING (No. 4)

The Strathpeffer "Challes"

Previously known as the "Bridge Tank Water," and used to start a syphon from an upper to a lower reservoir, this spring was first chemically examined by Mr. Hayton Davis, F.C.S., with the writer, in 1887. It was at once evident that the water was one of exceptional interest and value. After repeated trials a gravitation service was

complete analysis of all the Strathpeffer waters. Those acquainted with waters of this kind will at once notice that "sulphur in suspension" is noted as occurring in all the old analyses. The presence of "sulphur in suspension" indicates that the water is not fresh, and vitiates to a great extent the estimation of the various sulphur elements.

devised and the water conducted to the small wooden pavilion where it is at present served. It was opened for the use of invalids on 8th August 1892 by the Countess of Cromartie, after whom the new spring was named.

The following is extracted from Mr. T. Wellwood Maxwell's *Report on the Complete Mineral Analysis of the Challes or Lady Cromartie Spring*, dated 11th March 1895:—

“A sample of the water was syphoned from the source on 15th February after five or six weeks' severe frost. The temperature of the water as drawn off was 39° Fahr., the temperature of the air being 24° Fahr. The barometer stood at 30·00 inches. The sample was brilliantly clear.

“The *specific gravity* was 1001·175.

“The *total solid residue* at 300° Fahr. was 75·9 grains per gallon.

“There were present (in grains per gallon) *Silica* 0·64, *Alumina* 0·82, *Calcium* 4·83, *Magnesium* 10·91, *Sodium* 3·26.

“*Sulphur Constituents*.—Under this head are included sulphuretted hydrogen and those salts which contain sulphur in a state capable of

attacking iodine, viz. *Sulphides* and *Thiosulphates* (Hyposulphites).

“*Total Sulphur*.—70 cc. were titrated with iodine solution (of which 10 cc. equals 1 milligramme of sulphur), using starch liquor as an indicator. 74.6 cc. were required, equalling 7.46 grains of *sulphur* per gallon.

“*Thiosulphates*.—A quantity of the water was left in contact with excess of lead carbonate for over 24 hours, with occasional agitation, and filtered. The filtrate gave all the indications of thiosulphate. 70 cc. titrated with iodine required 0.6 cc. of the solution, equal to 0.06 grains of sulphur per gallon, or 0.3 *sodium thiosulphate*, $\text{Na}_2\text{S}_2\text{O}_3$.

“*Sulphides*.—By direct experiment with solution of sodium sulphide of a known strength it was found that evaporation decomposed the salt. The alkalinity of the solution, however, remains the same, the sodium salt, whether sulphide or hydrate, having the same acid-attacking power. It was found that one degree of alkalinity was caused by 0.582 grains per gallon of sodium sulphide, whilst sodium thiosulphate is perfectly neutral. The soluble residue from 70 cc. of the

water was then titrated with the acid solution and found to have 3·75 degrees of alkalinity. This is equivalent to 2·18 grains of *sodium sulphide* per gallon, Na_2S .

“*Sulphuretted Hydrogen*.—Deducting the sulphur of the thiosulphate and sulphide of sodium, there are 6·51 grains of sulphur, existing as free H_2S ; that is 6·92 grains (equivalent to 19·03 cubic inches) of *sulphuretted hydrogen* per gallon.

“The water was decidedly alkaline.

“There were present 1·8 grains of *Chlorine*, and 35·83 grains *Sulphuric acid*. The *hardness* by Clarke’s soap test was 13·3 degrees.”

The sulphur strength of the Cromartie Well has been carefully determined several times, and on three of these occasions a little more or less than 11 grains of sulphur per gallon were found. This is equivalent to about 31 cubic inches of sulphuretted hydrogen gas. These figures very considerably exceed the maximum observations hitherto recorded of any British sulphur water; and it is necessary to go to the Continent of Europe in order to find a water so powerfully impregnated with sulphur as the Cromartie Spring.

RESULTS OF ANALYSIS OF THE LADY CROMARTIE WELL

I. SOLIDS.	Grains per Gallon.	
Silica	0·64	
Alumina	0·82	
Iron	traces	
Calcium Carbonate	12·09	
Magnesium Carbonate	8·79	
Magnesium Sulphate	38·97	
Magnesium Chloride	2·41	
Sodium Sulphate	5·81	
Sodium Thiosulphate	0·30	
Sodium Sulphide	2·18	
Total solids	72·01 ¹	
II. GASES.	Grains.	Cubic inches.
Sulphuretted Hydrogen	6·92	19·03
Carbon Dioxide	18·07	38·43

There rises at Challes, near Chambéry in Savoy, a sulphur spring that is supposed to be the strongest in Europe. According to the French analysis the *Eau de Challes* contains from 13·8

¹ The difference between this result and the total solids obtained by evaporation (75·5 grains) is probably due principally to the sulphur formed during the latter process by the decomposition of sulphuretted hydrogen.

to 14·7 grains of sulphur per gallon. The water is of an alkaline reaction; and in consequence of the presence of bicarbonate of sodium, the sulphur takes the form of sulphide (Na_2S) or sulphydrate of sodium (NaHS). During a visit to Challes in March 1894, the writer had an opportunity of estimating the sulphur by the process employed at Strathpeffer. Two estimations gave a result of about 7 grains, and a sample bottled and subsequently examined at Strathpeffer gave $6\frac{1}{2}$ grains per gallon, results that are no doubt considerably below the normal strength. In order to obtain results that are accurately comparable, as between different mineral waters, the same methods of analysis ought as far as possible to be employed.¹

The following table exhibits the Cromartie and Morrison Wells at Strathpeffer in comparison

¹ Mr. Maxwell notes: "I have twice tried the method of estimating soluble sulphides (including H_2S) recommended by Dr. Garrigou in his pamphlet on *Challes*, by treating the solution with lead carbonate, oxidising the resulting sulphide by means of nitric acid, and weighing as sulphate. This process was not successful in my hands. I found, however, that lead carbonate answered very well for removing the sulphides to make way for the estimation of thiosulphates."

with the *Eau de Challes* and the strongest sulphur water at Harrogate :—

GRAINS OF SULPHUR PER GALLON.			
	As Sulphide or Sulphhydrate of Sodium.	As Sulphur- etted Hydrogen.	Total.
Eau de Challes (Garrigou)	12·8	1·0	13·8
Strathpeffer— Cromartie Well (Maxwell)	0·95	6·51	7·46 (Maximum, 11·1)
Morrison Well (Maxwell)	0·25	6·23	6·48
Harrogate— Old Sulphur (Thorpe)	2·90	3·56	6·46

In the amount of total solids the Cromartie Well occupies a position intermediate between the Morrison and Castle Leod Wells, and again closely resembles the Eau de Challes (about 70 grains per gallon). It was the general resemblance to the last-mentioned water that first suggested that it should be named after the famous French Spa. Complete analysis, however, reveals important

differences—for example, in the form in which the sulphur occurs, and in the degree of alkalinity. It is important to avoid in the naming of springs any possible ambiguity or confusion. The science and literature of mineral waters has become more and more international, and it is probably better not to apply the name of foreign waters, however similar, to those of Great Britain.

It is to be noted that the sulphur very readily breaks away from its combination with hydrogen, or with alkaline metals. Heat, agitation, or exposure to the air, soon bring about this decomposition. It is, therefore, very advisable to “take the waters” fresh from the well. No doubt the very instability of the constituents renders their action in the system more active and immediate. The older chemists were of opinion that this loosely combined attachment of the sulphur and the hydrogen was altogether special to natural mineral waters.

The rock out of which the sulphur waters of Strathpeffer flow, and from which, in the course of long subterranean travel, they no doubt derive their chemical properties, has been analysed by

J. McG. Ross, Esq., of Alness. The following are his results :—

	Per Cent.
Bituminous Organic Matter, and Water .	4·8
Sulphate of Lime	10·3
Carbonate of Lime	45·0
Carbonate of Magnesia	19·1
Carbonate of Iron	1·6
Insoluble (Silicates, etc.)	18·8
	<hr/>
	99·6

CHAPTER III

THE CHALYBEATE SPRING

THE Chalybeate or Iron Spring, some years since conveyed to the Pump Room, rises near the Raven Rock, three miles distant, where it has been known, probably for centuries, as the "Saints' Well." It is one of a group occurring in the neighbourhood, all more or less similar in character, but which have hitherto attracted but little attention. The pedestrian will notice here and there springs with a bright ochre-coloured deposit (carbonated oxide of iron). One of the most remarkable of these, which has a strong chalybeate flavour, is found on the railway a little west of Auchterneed station.

In all these springs the iron exists as a carbonate, which would be quite insoluble did not

the water contain an excess of free carbonic acid gas. Therefore it follows that exposure to the air, by dissipating this gas, allows the iron to fall as a precipitate. On allowing a glass of the water to stand aside for two or three days, a brown sediment of the oxide of iron falls to the bottom, and the surface exposed to the air is coated with the same oxide as a thin iridescent pellicle.

ANALYSIS OF THE CHALYBEATE WATER OF STRATHPEFFER

BY DR. STEVENSON MACADAM

ANALYTICAL LABORATORY, SURGEONS' HALL,
EDINBURGH, *6th July* 1871.

Analysis of sample of water from Saints' Well,
Strathpeffer.

One Imperial Gallon contains—

	Grains.
Carbonate of Iron	2·46
Carbonate of Lime	3·14
Chloride of Sodium	1·17
Sulphate of Lime	1·13
Chloride of Magnesium	0·38
Carbonate of Magnesia	0·41
Phosphates	0·19

	Grains.
Soluble Silica	0·21
Organic Matter	0·47
<hr/>	
Total Matter dissolved in Imperial Gallon	9·56
Hardness $7\frac{1}{2}^{\circ}$.	
	Cubic Inches.
Total Gases dissolved in Imperial Gallon	12·68 ¹
Per Centage Composition of the Gases—	
Carbonic Acid	31·98
Oxygen	20·34
Nitrogen	47·68
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	100·00

Some general observations on the medicinal uses of mineral waters will be found in the next chapter. They apply with especial force to the class of Chalybeates. It is well known that the absorbing power of the stomach for iron is extremely limited ; and that the most effective absorption is in general obtained when very *small doses* are presented in *dilute solution*. The amount of iron required by the blood is itself

¹ At the time of Dr. Macadam's analysis the spring was exposed to the air. When it was at a later date carefully closed in at the source, the gaseous contents appeared to be much increased. No further analysis has been made ; and whether the free gas now present in the water at the Pump Room is all carbonic acid gas has not been sufficiently determined. It is curiously variable in amount, and is sometimes nearly absent.

minute, and could readily be made up, if absorption were active, by a natural Chalybeate like that of Strathpeffer, with a quarter of a grain of the carbonate dissolved in sixteen ounces.

The first effect of this Chalybeate is stimulating, occasionally in a marked degree, giving rise to feelings of exhilaration, flushing of the head, and even staggering. Ladies, in particular, have sometimes complained that the "iron water intoxicated" them. The same observation has often been made in the use of similar waters at Spa, Pyrmont, and other places. These effects are due to the presence of Carbonic Acid Gas. This gas imparts to the water not only a pleasant and refreshing taste, but also a light and digestible quality, adapted to delicate stomachs. Hence the Chalybeate can often be borne, and is in fact repeatedly taken with advantage, where ordinary Iron Treatment is quite inadmissible—for example, in the common case where poverty of blood in young persons is complicated by indigestion and irritability of the stomach. The water, drunk in effervescence, stimulates the appetite and the digestive process in virtue of the carbonic acid gas, whilst the tonic

effects due to the absorption of iron afterwards follow.

In addition to common *anæmia* and *indigestion* of younger life, the Chalybeate exerts a valuable influence at a later age in persons of relaxed and debilitated habit, more particularly in those affected by a commencing degenerative disease of the blood-vessels and kidneys. This condition is sometimes met with in those who come to Strathpeffer for *gout*. At an earlier stage of the malady the treatment by iron would not in general be applicable, yet later on the Chalybeate may prove a most useful remedy in the treatment, not of gout, but of the more serious affections arising out of it. The same water is applicable in the debility and anæmia resulting from *malaria*. Lastly, a short course of this water is not infrequently prescribed as a tonic, after a longer period of Sulphur Treatment. On the other hand, those who come to drink the iron spring are in some cases benefited by a week or two of sulphur, to pave the way for the tonic water.

The Chalybeate water is now served hot as well as cold. The increase of temperature, as in

the case of the sulphur waters, favours absorption, and so materially intensifies the Chalybeate action.¹

¹ See the Author's "Observations on the Use of the Effervescing Chalybeate of Strathpeffer Spa," *Brit. Med. Journ.* 5th May 1888.

CHAPTER IV

THE RATIONALE OF MINERAL WATER TREATMENT

THE ancient *practice* of treating disease by mineral waters gains rather than loses support with the advance of medical science. The *theory*, which is altogether a different matter, may be changed in this or disproved in that particular ; some of the older pretensions, not more extravagant here than elsewhere, may fall to the ground, but the practice itself survives, and founds itself more and more surely with the lapse of time upon a permanent scientific basis.

The prime virtue of natural waters as a remedy is this, that they hold their constituents *in a state the most favourable to absorption*. That is no slight title to favour. When it is considered that in many chronic disorders the function of absorp-

tion is itself deranged, how important it becomes that the curative agent should be presented in the most acceptable mode. It is the province of the physieian not only to prescribe the right remedy, but so to prescribe it that it shall find its way into the tissues, and this mineral waters often enable him to do.

It is of course obvious that waters of all kinds hold their contents *in solution*. That is of itself favourable to absorption; for, indeed, solution is the needful preliminary to absorption—so important that to it the whole work of digestion is devoted. When matters are dissolved, the component particles are separated, and are therefore more free to act upon any surface with which they come in contact. The active operation of the particles is further intensified in the case of watery solutions by the penetrating power of the fluid in which they are dissolved, and by the chemical affinity of water for the living tissues. A watery solution may be of any proportion, from the point of saturation (strongest possible solution) to the vanishing point (weakest possible). In the case of all the natural waters (for internal use)

it will be found that the solution is, as to strength, a long way below the point of saturation.

The next characteristic of mineral waters is *free dilution*, which diminishes the local activity of the dissolved matters in such a way as often to remove altogether a certain class of effects—for example, caustic or astringent effects—which are antagonistic to absorption. These being removed by dilution, absorption takes place, and an opportunity is then given for the development of a new series of effects, both local and general. The first difficulty is to pass the gates of Absorption. And here at the outset the remedial agent is resisted and excluded, unless accompanied by a proper degree of dilution.

The therapeutic effect of a mineral water is therefore compound, being in part assignable to the water of dilution, and in part to the particular constituents dissolved in it. When the bulk imbibed does not exceed the normal allowance of water in health, the first element may be neglected. On the other hand, it is quite usual for persons under Spa treatment to drink twice, or three or four times, their normal allowance of fluid, or even

much more, and therefore the effect of an excess of water must not be lost sight of. Pure water, when carried into the stomach, very soon leaves that organ. It is conveyed away by the veins, and yet it has no appreciable effect in increasing the fluid contents of the blood; the pulse-frequency may be somewhat lowered, and the blood pressure slightly raised. The imbibed water then rapidly distributes itself among the tissues of the body, and stimulates the circulation of the fluids. The *washing-out* of the tissues, always more or less in process, is thus promoted; and naturally there is an augmented removal of waste matter, and of water itself, by the kidneys and by the skin. For these reasons water-drinking is recommended when it is desired, by irrigation of the tissues, to wash away waste matter or poison, or to promote the absorption of deposits and exudations. An abundant use of hot water, or cold, in some form or another, is the main factor of medical treatment in many conditions of chronic disorder, where these ends are in view. For precisely the same purpose many such cases frequent the Mineral Spas, where the use of water may be had, combined

with every circumstance of advantage to health, in climate, diet, and simplicity of life. On the contrary, no one should come for treatment to mineral waters in whose case, from any cause, the free use of fluids is inadvisable. So much may be affirmed of the watery vehicle, the element which permeates Nature, and even in the human body amounts to nearly sixty *per cent* by weight. Its vast preponderance in all mineral springs has inclined some persons—reacting too violently from the bad science of the past—to neglect entirely what they regard as the “insignificant proportion” of the dissolved ingredients.

It is a remarkable circumstance¹ that some of these ingredients occur in a form or composition not available elsewhere than in mineral springs. For example, Carbonate of Iron springs, like the Strathpeffer Chalybeate, hold in solution the proto-carbonate of iron; and in no other form can it be presented *in solution* for absorption. Take again Sulphur Waters, which contain in a volatile and gaseous form an active drug, which is not,

¹ *Treatise on Mineral Waters*, by William Saunders, M.D.,
F.R.S., F.R.C.P., 1805.

apart from such waters, employed in medicine. It is true that in the ordinary administration of sulphur in bulk chemical changes take place *in the body*, by which sulphuretted hydrogen is produced, and so enabled to exercise its effect upon the tissues. But this secondary formation of the gas takes place, for the most part, in the intestines, and not in the stomach, where absorption of fluids and gases is most active. This is an important circumstance. The alterative or intimate effects of sulphur in the tissues are, as will appear in the next chapter, of a special nature; but to obtain them in their full force it is needful in the present state of science to have recourse to sulphur waters.

Another character of the ingredient is that it is presented in comparatively small doses. Salines, Iron, Sulphur, are habitually prescribed in much larger doses than are found in mineral waters, mixed in the laboratory of Nature. How much of this excess may be needful simply to compensate for defective absorption? In the use of iron it is often observed that the small dose in an acceptable form is more effective than a much larger dose in another form. Again, the activity

of the ingredient and the effect of the dose are increased, within certain limits, by dilution, for thereby "it is diffused equally over the extensive surface of the stomach, and is enabled to act all at once in the most advantageous manner possible."¹ Further, when, as in the case of sulphur waters, the chief ingredient is a gas, it is futile to employ the scale of dosage applicable to solid and liquid matters.²

¹ Saunders, *loc. cit.* "There cannot be a doubt that free dilution exereises a most important influence on the action of almost all the remedies which prove useful in this class of disorders; and that a dose which would excite nausea and irritation of the stomaech when taken in a concentrated form is often prodnetive of excellent results when aided in its action by water. Hence probably the wonderful efficacey of the natural mineralised waters, and hence also the superior effects which often ensue after taking the weak infusions or teas which are the favourite remedies of the poor and the nostrums of so-called herbalists. I am firmly convinced that our medicines frequently fail in their operation for laek of sufficient dilntion. . . . Sulphur is an agent which sometimes proves peeuliarly valuable in the treatment of ehronic rheumatism, espeecially when the skin is inactive."—*Rheumatism, Rheumatic Gout, and Sciatica*, by H. W. Fuller, M.D., 1864, pp. 364-365.

² Mr. Darwin, experimenting by dosage of certain plants, brought a quantity of phosphate of ammonia nearly equal to a one-twenty-millionth part of a grain into *effective contact* with a sensitive structure, the gland upon the leaf of a sundew. The tentacle moved upon this infinitesimal stimulation: the dose produced its effect.—*Insectivorous Plants*.

CHAPTER V

THE MEDICINAL PROPERTIES OF THE SULPHUR WATERS

ACCORDING to the latest analyses the Morrison Well at Strathpeffer contains 17 or 18 cubic inches of sulphuretted hydrogen gas in the imperial gallon, in addition to about 2 grains of alkaline sulphide. The latter may be accepted, medicinally, as equivalent to an additional portion of the gas.¹ It does not appear that any valid therapeutic distinction can be drawn between the alkaline and the hydric sulphide. Taken together, these sulphur compounds are the prime ingredients of the Strathpeffer water. The presence of the salts of lime, and of the sulphates and chlorides

¹ "Sulphurets only produce an effect by their oxidation and partial transformation into sulphuretted hydrogen."—*Curative Effects of Baths and Waters*, Dr. Braun, p. 413.

of magnesium and sodium in varying proportions in the different wells, undoubtedly modifies the action of the sulphide. These differences in saline constitution as well as in the charge of sulphur give a considerable variety of therapeutic action to the Strathpeffer sulphur waters, and render them more or less suitable in different cases.

None of the wells contain more than a small amount of chloride of sodium (common salt); and in this respect lies the great distinction, medically, between the Strathpeffer waters and those of Harrogate. At Harrogate the special effects of the sulphur are powerfully modified by the presence of nearly 900 grains of this salt per gallon (Royal Pump Room).¹ The English water is therefore a bitter or purging sulphur, whilst that of the Highland Spa is by comparison a pure or simple sulphur water. The effects produced are mainly those of the sulphur elements, and when purging is desired salines are added.

¹ "Unfortunately it (the strongest Harrogate water) cannot be used without imbibing in every pint some 120 grains of salt, a quantity obviously sufficient to interfere with the simple effect of sulphur water, whether as drunk or used for bathing." —*Our Baths and Wells*, John Macpherson, M.D., London, 1871.

Some importance attaches to the fact that the prime ingredient of the Strathpeffer water is a gas, Sulphuretted Hydrogen. The physical properties of gases are peculiarly favourable to absorption, for in the gaseous state of matter the forces of cohesion have been overcome by *repulsion*, and the particles are in a state of the most perfect *mobility*, tending to fly off in every direction. Gases also possess a high penetrating power, or power of *diffusion*; and in addition, a peculiar attraction for the surfaces of solid and liquid bodies, in virtue of which the latter are able to absorb them, sometimes to a surprising extent. Sulphuretted hydrogen gas exhibits in a high degree all these physical properties. The property of absorption is particularly well marked, sulphuretted hydrogen being in this respect considerably more active than carbonic acid, and very much more so than elementary oxygen and hydrogen. It is further an inflammable gas and freely soluble in water,¹ from which, however, it is readily liberated,

¹ Water at ordinary temperature will dissolve a little more than three times its own volume of sulphuretted hydrogen. In the Strathpeffer "Morrison Well" (analysis 1857) the strength is one volume in twenty-four of water, that is to say one

especially on agitation or by the application of heat. Hence when sulphur waters are taken into the stomach, the medicinal gas is applied to the entire absorbent surface of that cavity.

When inhaled in considerable quantities by the lungs, sulphuretted hydrogen is a poison, destroying life by its destructive action on the tissues, but particularly on the blood. Dissolved in water and presented in moderate doses to the stomach, it is freely absorbed; and, whilst producing no immediate or obvious effect on the blood, exerts both upon it and through it upon the tissues a slow "alterative" action. This shows itself in a modification of the processes of waste and repair, particularly in the tissues of the joints and skin.

It is worthy of remark that the active absorption and diffusion of this gas in the body are indicated by the blackening of silver articles worn next the skin whilst the waters are being taken internally.

The Strathpeffer waters are drunk either hot or cold, and usually one hour or more before food.

seventy-ninth of full saturation. It is doubtful whether a stronger impregnation than this would be generally tolerated by the stomach.

Warmth stimulates absorption, and so places even the strongest of the waters within the power of a weak digestion, when given carefully in small doses. In the majority of cases the waters are not in themselves aperient, but rather the contrary. In the stomach, particularly at the commencement of treatment, they sometimes "lie heavily," and do not produce the refreshing effect of carbonated waters. In course of time, however, as the stomach becomes habituated to their presence, this passes off, and a sense of strong hunger is felt after their use, generally combined with a greatly increased power of digestion.

The influence exerted by sulphur water on the liver is important. It is difficult, if not impossible, to frame a satisfactory theory to account for all the effects produced; but the fact is accepted that in cases of enlarged liver the administration of sulphur very generally reduces the enlargement, and brings about a healthier condition, not only in the functions of the liver, but in the closely related function of the disposal of waste.

In what manner sulphur exerts an alterative influence in the blood and tissues we do not

know. The most noticeable effect is a general acceleration of tissue change, both destructive and constructive. Hence sulphur powerfully contributes to the removal of those long-continued disturbances of nutrition on which chronic ailments are based, especially in the digestive organs, joints, or skin. Chronic catarrhs, conditions of deficient or defective repair, and accumulations of waste products, commonly yield sooner or later to the imbibition of these waters. Excretion is stimulated, and the functions of the kidneys and skin are increased. The value of the Strathpeffer waters in some kinds of kidney affection and for gravel is traditional, and good service is certainly done in washing away gouty obstructions and deposits from these organs, as well as other kinds of gravelly concretion.

Sulphuretted hydrogen is freely absorbed, not only by the stomach, but by the lungs and skin, and it is by the skin and lungs that it is most freely eliminated. Experiment has long since shown¹ the elective affinity of the bronchial mucous membrane for this gas, and the astonish-

¹ Claude Bernard, 1857 ; Laborde, 1881.

ing rapidity with which it reaches this membrane when introduced into the circulation. Hence the value of sulphur waters in asthma and chronic catarrhs and congestion, whether bronchial, pharyngeal, or nasal.

Sulphur is applicable to a large class of chronic ailments. The main reliance is to be placed on the *internal* use of the waters, even in localised affections. The *external* use, by baths, inhalations, and otherwise, often materially aids the cure, but would seldom suffice by itself. Improvement in general health usually precedes the removal of local troubles. The action of sulphur waters is gentle, and slowly manifested. The full effect of the course is seldom declared until weeks or months have elapsed. This is especially found to be the case in chronic eczema and other skin affections. It is, however, claimed that, although the benefits arising from these waters may be delayed, they are of an enduring character.

The following are the principal indications for the use of the Strathpeffer waters.

Among affections of the stomach *atonic* and *catarrhal dyspepsia* take the first place. In this

affection the catarrh usually extends beyond the area of the stomach itself. The mucous membrane is no doubt congested and covered with a tenacious layer, and there is on this account a more or less widespread defect or deficiency in the power of absorption. When the dyspepsia is accompanied by *constipation*, the use of the Upper Well in the morning is often sufficient to correct it; but where a more powerful dose is required, a teaspoonful or more of one of the salines is commonly taken, dissolved in the early morning draught of the Spa water. There are also cases in which some preliminary doses are advisable at the commencement of the treatment.

Affections of the liver are benefited at many Spas, and notably by sulphur waters. Both chronic disorders of this organ and functional derangements, which are more common, do well at Strathpeffer. The large, congested, and perhaps tender liver is reduced in size; and, what is exceedingly important, the system is cleared of the waste matter which is always present in excess. The Mineral Water Treatment is often aided by Douche Baths and Massage. But it

cannot be expected to avail (and the neglect of this rule may account for some disappointments) unless there be observed a due conformity with the strictly regulated diet and regimen of a Health Resort. Another condition of this organ is sometimes spoken of as *tropical liver*. It may accompany other disorders, discovered perhaps in middle or later life, in those who have been long exposed to unhealthy or malarial influences in a hot climate. Persons so affected frequent all the Spas, and they usually do well at Strathpeffer.

Another very common digestive affection arises out of the present conditions of civilisation. It is marked by fulness or *plethora*, especially of the liver and abdominal organs, and results from indulgence in an over-stimulating diet whilst leading an inactive and sedentary life. Here also important districts of the circulation are both sluggish and loaded, and there is imperfect elimination of waste, causing perhaps distressing symptoms of nervous depression, languor, and so-called "biliousness." In this ailment also, sulphur water, the first daily dose of which may suitably be taken *hot*, with or without salines, is (with regimen) a

very successful treatment. The same may be said of many forms of *jaundice*, whether due to the presence of gallstones or to catarrh. The writer has known two cases in which jaundice (from the first cause) *supervened* in the course of Sulphur Water Treatment; but the risk of this contingency is, however, very remote, and does not detract from the value of the treatment.

Intimately related both to disorder of the liver and to plethora there is, in the next place, a large group of cases in which the circulation and tissues are burdened, not only by an excess of waste, but by an excess of *acid material*. Here the normal processes of tissue change are perverted, and the kidneys are also very generally at fault. Short of true *gout*, which is the most characteristic member of this group, there are varieties of *acidity*, differing according to the region in which the predominant effects are manifested. Assuming that no acute disease is present, and that there is nothing to make the administration of fluids inadvisable, such cases are certain to benefit by a course of sulphur waters.

With reference to *gout*, the writer's experience

has persuaded him that, although in exceptional cases Spa treatment may be successfully given very soon after the acute attack, it is but rarely to be recommended until a considerable interval has elapsed. Even after an interval threatening pains often return to the affected parts, when the waters have been taken for a few days; which may be accepted as an indication of the influence they exert on the seat of the disease. Sulphur waters are an invaluable *preventive* of gout; and, according to this view, succeed *best* in removing the cause when the periodical effect is in comparative abeyance. In many cases after repeated visits to the Spa the attacks cease. But it is to be remembered that the process of arresting a constitutional error is, above all things, gradual, and needs the persevering and repeated use of the remedy. And not only so, but also a religious avoidance of all the original causes of mischief.

A later stage in these disordered or perverted processes is presented in the persons of those who have had gouty symptoms for many years, and now labour under some more serious organic malady. Without unduly enlarging on this point,

it may be well to state that in such cases the greatest caution is needful in the use of mineral waters and baths. Yet curious to relate, if ample time be allowed, some of the most striking successes are met with under these very unpromising conditions, by means of a mild Sulphur and Chalybeate Treatment, applied sometimes singly and sometimes in successive courses.

Among affections of the kidneys, not included in the last group, cases of simple acid concretion do well at Strathpeffer. In advanced degenerative disease sulphur waters are inadmissible; but it has been already pointed out in Chapter III. that Chalybeate Treatment may often be used with success.

Stiff limbs and mineral waters have always been associated, both by medical and popular prescription. Hence *rheumatism* is the most frequent of all diseases at the Spas, but how many separate ailments are comprehended in that elastic term! It may be well at once to say that the Strathpeffer waters are forbidden in all acute inflammatory conditions of the joints, whether from gout or rheumatism. The rule that has just been stated with reference to gout applies also to

rheumatism, that it is not wise to resort to waters too soon after the acute attack. Such a course invites a recurrence of the disease, which not infrequently takes place in gouty or rheumatic persons who come to Strathpeffer after acute illness and prescribe the waters for themselves. The more recent the illness, the greater must be the caution in the use of sulphur waters. The same remark applies, with even greater force, to all kinds of baths. Once the acute period has passed the waters may be confidently used, in gradually increasing doses, and no treatment is better adapted to overcome the *results* of gouty and rheumatic attacks on the tissues. The troublesome pain, swelling, and stiffness are nearly always removed under their use, and the joints resume their natural condition. Strathpeffer is in this way particularly helpful in chronic gout, and in the convalescence from acute and subacute rheumatism.

In the numerous forms of *chronic rheumatism*, whether of the joints or fibrous tissues, the sulphur waters are also indicated, their favourable effect depending, no doubt, on the increased activity of

tissue change that follows their use, as above described. Some systematic thermal treatment, by Douche or Peat Baths, may be appropriately given in these cases.

There is another very different class of complaints, in which the earlier observers considered the Highland Spa peculiarly helpful. In *chronic tubercular* or *scrofulous affections*, whether of the mucous membranes, lymphatic glands, bones, or skin, a mild course of sulphur waters is often beneficial, provided there is no inflammatory or febrile state. Sulphur heightens and stimulates the physiological activity, and it has been well observed by Royet¹ that a healthy physiological activity offers the best resistance against invasion by micro-organisms. Hence the preventive value of a course of sulphur waters in the convalescence from typhoid fever, measles, and whooping-cough, when the normal resistance is lowered. The activities of tissue change are disordered or depressed. That is the opportunity for tubercular invasion ; but when healthy activity is restored, the

¹ In his philosophical treatise *La Medication de Challes*, p. 26, Paris, 1891.

invaders are powerless. It has been well said, by another French writer, that the heredity of tubercle is a question, "not of the seed, but of the soil."

Cases of *chronic phthisis*, such as results from repeated attacks of pleurisy or pneumonia, do well at Strathpeffer, particularly in the winter months. If no inflammatory conditions are present, the waters are taken in small doses, with marked improvement in the general health.

Reference has been already made to the employment of sulphur waters in *chronic catarrhs* of the throat, nasal passages, and bronchial tubes. Their internal use should in these cases be supplemented by inhalations and local douches.¹

Lastly, the waters of Strathpeffer are indicated in many *chronic skin affections*. More particular reference to this subject will be found in the chapter on the Baths. Here it is sufficient to mention *chronic eczema*, which nearly always yields

¹ A small experimental inhalation chamber was fitted up at Strathpeffer some time since. Inhalations, pulverisations, and local douches of sulphur water have hitherto been used (and with encouraging success) much more in France than in this country. It is to be hoped that as the value of the treatment becomes recognised, a more extended provision will be made for it at Strathpeffer as well as at the other British Sulphur Spas.

to a persevering and repeated Sulphur Treatment, *acne*, and some forms of *psoriasis*. Baths of sulphur water, which can be heated without dilution by a so-called *therma* apparatus, are commonly employed in these cases. It has been already observed that the amelioration of severe and long-standing eczema comes sometimes with slow and lingering steps; but there is no affection to which the Strathpeffer waters are more applicable, or in which the results are more satisfactory.

More or less anæmia sometimes results from a prolonged use of the sulphur waters, and it is often well to complete the treatment by a course of the carbonated Chalybeate. Experience also shows that there is a point at which symptoms of "saturation" set in, if the use of sulphur is unduly prolonged. The employment of sulphur waters should in most cases cease before this point is reached.

Some of the more important *contra-indications* for the use of the Strathpeffer waters have been already alluded to. The conditions of the circulation that preclude their use are—(1) continuous and irreducible high arterial tension; (2) over-full

venous system, with sluggish current, whether due or not due to organic disease of the heart. The writer has several times seen apoplectic attacks, and attacks of hæmorrhage, result from the incautious use of sulphur waters in predisposed subjects. The waters are in many persons somewhat constipating. Their use is inadmissible unless the *primæ viæ* be freely open, or if any active dyspepsia be present; also in all acute inflammatory conditions, in ulceration of the stomach or bowels, and especially in serious affections of the kidneys. It will therefore be obvious that many invalids will be unable to take them to advantage; and that in many others some preparatory treatment will be necessary on arrival at the Spa.¹

“Great numbers,” writes a resident in Strathpeffer in 1792, “have resorted hither and use the waters of this mineral for all kinds of disorders, without exception.” He then goes on to say: “Most benefit has been derived from this mineral by those troubled with scorbutic complaints, and

¹ See the writer's paper: “The Sulphur Waters of Great Britain, an Examination of their Action and Uses,” Intern. Med. Congr., Rome, 1894.’

all kinds of external sores upon the body. It has been used with success in the gravel and stomach complaints." There is a species of satisfaction to be derived from learning that the indiscriminate use, and abuse, of the waters by ignorant persons has, at all events, the respectable sanction of old custom. But there is also in this passage the specification, by an evidently acute observer, of those affections which really did benefit by drinking the sulphur spring. Thus one finds in this century-old enumeration, substituting a more modern phraseology, *scrofulous* affections, *skin* affections, (chronic) affections of the *stomach* (indigestion and its allies), with calculous affections of the *kidneys* and their district.

These are among the chief disorders most favourably influenced by the same waters to-day. Some others, such as *gout* with its associated disorders, and *rheumatism*, and chronic affections of the *liver*, seem to have been happily unknown in the old time among the class of people then frequenting the Springs. But now they are found in large numbers, and to none is the Sulphur Treatment more appropriate. Therefore, with

exceptions or additions easily accounted for, the old verdict coincides very nearly with the modern one; and the fact may perhaps be taken as a testimony to the general truth of both of them.¹

¹ See Appendix: "Dr. Thomas Morrison's Directions to the Ladies and Gentlemen frequenting Strathpeffer Spa, 1822."

CHAPTER VI

THE BATHS

THREE ways or roads are open for conveying into the body the sulphur that exists in sulphur waters. The first and most important has been already considered. It is the way of the *stomach*, by drinking. But if entrance be here denied, from temporary causes or excessive delicacy of the digestive organs, two other ways are open. The way of the *lungs*, by inhalation, has been also referred to in the previous chapter. Lastly, there is the way of the *skin*, by the external use of these waters in the form of lotions and baths.

Sulphuretted hydrogen gas is absorbed freely, not only by the stomach and lungs, but by the skin, and in this respect the Sulphur Bath differs from almost all other known mineral baths, in

which it is believed no actual absorption by the skin takes place. The subtle and penetrating quality of sulphuretted hydrogen gas is here once more illustrated. Under the *internal* use of the water it makes its way, as has been already observed, outwards to the skin; and under its *external* use in the form of baths there is good evidence that the sulphur finds its way to the internal organs.

When warm sulphur baths are employed the effect of temperature is, of course, superadded to that of the absorbed gas, and the warm sulphur bath becomes an important auxiliary to the internal use of the waters, particularly when it is desired to make an impression on parts near the surface, such as the joints and skin.

In addition to its alterative action when taken internally, sulphur exhibits a local action, both on the skin and mucous membranes; and some writers have described a "remote local action" of sulphuretted hydrogen, not manifested at the point of application, but on tissues like the skin and joints, to which it is carried in the course of circulation. This, however, would seem to be essentially an alterative action, produced in those parts selected

by the remedy. In its true local action sulphur is stimulant to the vascular and sedative to the nervous systems, and hence probably the effect of outward applications in relieving pain.

To obtain these therapeutic effects in the case of skin affections, the waters must be taken both internally and externally. The main reliance is to be placed on their internal use, but the way of the skin possesses, in disorders of that organ, the advantages attending the local action of the remedy.

The Sulphur Baths of Strathpeffer contain only a very small amount of mineral, that is of saline, constituents. In this respect they differ from nearly all the sulphur baths of Great Britain, which contain, in addition to sulphur, large quantities of chloride of sodium (common salt). The latter is the main constituent of sea-water and of brine baths, such as those of Droitwich. Baths so impregnated, although valuable in other ways, have, as a matter of experience, a somewhat irritating effect on the skin, unknown to the pure sulphur bath.

In addition to the question of saline matter, some importance attaches to the form in which

the sulphur itself occurs. Since the alkaline, or fixed, sulphides cannot be absorbed by the unbroken skin,¹ the specific effect of sulphur baths must be attributed to their charge of free sulphuretted hydrogen. In this connection it is worthy of notice that some of the most famous thermal sulphur baths are almost destitute of this gas! Of those in the Pyrenees, for example, Barèges has none, Luchon and Cauterets only traces. The sulphur at these Spas is in alkaline combination. On the other hand, in the Strathpeffer sulphur bath almost the entire sulphur is present in the gaseous form—in the form, that is to say, most favourable to absorption. With a soft water, free of briny salts, and holding its sulphur (the wells used for bathing are here referred to) in the gaseous form, Strathpeffer affords every opportunity for the local use of sulphur, particularly in skin affections.²

¹ Dr. Braun, *Curative Effects of Baths and Waters*, p. 267.

² The utility of sulphuretted baths depends to a considerable extent on the methods used in the storage and heating of the waters. Considerable improvements have been effected at Strathpeffer in these respects, and some of the sulphur baths are now heated by a "therma" apparatus without dilution of the water. In order to obtain baths with the least possible

The warm sulphur bath is indicated in the condition of dry, sluggish, or inactive skin, whether the inactivity be mainly that of the glandular elements or of the circulation. Also, at comparatively low temperatures, for the over-sensitive and irritable skin, in which the nervous elements are no doubt involved. These local conditions often accompany or depend upon some chronic constitutional disorder, for which recourse may properly be had to some general Spa treatment. In addition to these more or less functional disturbances, sulphur baths are useful in many conditions of skin *disease*, in which nutrition has become variously perverted, from local and other causes : for example, in *eczema*, *acne*, *psoriasis*, etc. The temperature, duration, and frequency of the baths must be adjusted with much care, particularly in *eczema*; and in some phases of *eczema* baths are best avoided. In many others great benefit is derived from their use, particularly in

loss of the volatile sulphurous ingredients, it has been proposed to erect some new baths at a somewhat lower level in the valley, and to serve them, as well as intermediate reservoirs, by gravitation of the water from its source. Having as a starting-point a strongly sulphuretted water, it should not be difficult by such means to provide at Strathpeffer a very powerful sulphur bath.

the irritable desquamative forms, either general or limited, and in the localised chronic dry eczema, often associated with gout; also the moist relapsing eczema met with in middle-aged persons of stout habit. The soothing effect of the warm sulphur bath is here very remarkable, but an internal use of the waters is nearly always recommended as well. In other cases of irritable, moist, localised eczema, a *lotion* of the water is often found beneficial. It is perhaps worthy of note, and may assist the selection of cases for these waters, that at Strathpeffer experience shows that those skin affections are always more amenable to the treatment which are associated with the gouty constitution. In fact there is seldom, if ever, occasion to despair of such a case. The sulphur baths are also employed in subacute and chronic rheumatism (both of the joints and fibrous tissues) and in chronic gout.

From the foregoing observations the reader will observe that *Thermal Treatment*, as a curative agency, is not disregarded at Strathpeffer. It forms, indeed, an important auxiliary at a Sulphur Spa, for, in many cases, Thermal Treatment may

be advantageously combined with the use of sulphur internally. And it is only when patients are enabled, as at Spas, to adjust their lives for some weeks to rather exacting requirements, that it is possible to attempt the one or the other.

One of the most important of thermal agencies is the *Douche Bath*, which was introduced at Strathpeffer in 1886. Besides its ordinary use in rheumatic and gouty conditions of the joints, the douche is employed in painful affections of the nerves and muscles—for example, sciatica and muscular rheumatism. The cold or tepid douche, and different forms of alternating douche (so-called Scotch Douche), are chiefly valuable on account of their tonic effects, and are employed in various conditions of debility, and in case it may be required to moderate the effect of more active thermal treatment.

The *Spinal Douche*, as employed at Strathpeffer, consists of very fine horizontal jets issuing from an upright tube, and is received upon the spine at a distance of a few inches. The water is generally of a considerable pressure, and the temperature ranges from 100° to 120°, or even higher. The

patient being comfortably seated, the application is continued for ten, fifteen, or twenty minutes, and the temperature and pressure of the douche varied or alternated at will by the attendant, without altering the position of the apparatus. Any other form of douche may be at the same time applied to other parts of the body. This treatment is particularly valued for its vaso-motor effects. Among the affections that have benefited from its use may be named *dysmenorrhœa*, *neurasthenia*, and conditions of *defective and sluggish circulation*.

Experience has shown that the above modes of treatment, though well suited to many cases in which a stimulant application is required, are quite inappropriate to another class of invalids, in whom any decided excitation of the circulation and nervous system should be strenuously avoided by the physician. All thermal treatment for such subjects must be at the same time gently sedative, or the danger will arise that in treating chronic ailments some more acute one may be awakened. In order to avoid any such risk, and to adapt the means to the end in view, a *Low Pressure Douche*

has been devised. The procedure at Strathpeffer is very similar to that of Aix-les-Bains. A large volume of water, *without pressure*, continually flows over the patient, who is seated. The temperature must be regulated according to circumstances, but it is seldom above blood-heat and often several degrees below it. The low pressure douche is employed in *general debility*, *malnutrition*, and *neurasthenia*, in the early stages of *rheumatoid arthritis*, in *senile localised arthritis*, and in the subjects of *rheumatism* and *gout* whose condition may be complicated by organic disease (perhaps *heart affection*), and for whom on this account ordinary baths would be contra-indicated. The Douche may, or may not, be combined with Massage, as at Aix.

Another form of thermal treatment extensively used at Strathpeffer is the *Peat* or *Moor Bath*; and since the medical employment of peat is comparatively new in this country, a somewhat detailed account of the methods employed at Strathpeffer may be here given. It is best described as a bath or poultice made by carefully mixing peat earth with hot water. The necessary material exists in

enormous deposits on the side of the neighbouring mountain, Ben Wyvis. It is there dug out at a certain depth below the heather, and conveyed to the Spa. It is then mixed by machinery to the proper consistency with water, and the temperature is subsequently adjusted by a jet of steam. The semi-fluid mixture, of a specific gravity of about 1040 (water being 1000), is poured from the mixer into a wooden bath for the better conservation of its heat, and these baths run on wheels into the several bath-rooms. After immersion in the peat, the bather takes an ordinary tepid bath, and usually a douche as well, at a suitable temperature. The Peat Bath, as commonly prescribed, is slightly above blood-heat, but it may range from 98° to 110° . Upon entering it and lying down, the first sensation experienced is that of weight, often amounting to slight oppression of breathing. The comparatively dense medium of the bath exercises a certain pressure on the entire surface of the body, and all movements are accompanied by a degree of friction, which is not experienced in ordinary baths. There soon follows in most cases a sense of augmented warmth and gentle stimulation,

which, with a feeling of increased vigour and general well-being, continue for a considerable time after the bath.

The Peat Bath is undoubtedly in the main a thermal agency, the effect varying with the degree of temperature and the duration. At the same time the peat earth of which it is composed contains much organic matter, and there can be little doubt that when it is heated for the bath, chemical transformations are set agoing, resulting *inter alia* in the formation of volatile acids. There must also take place from this cause continual minute changes of temperature in the substance of the mass. The question then arises, how much of the observed effect of the bath may be due to these chemical changes, with the development of stimulating elements and the fluctuations of temperature at the surface of the skin?

It is considered that Peat Baths irritate the skin more than ordinary baths at the same temperature, whilst they are attended with less excitement of the circulation and of the nervous system.¹ The writer's experience confirms this view. The general

¹ Braun, *op. cit.* pp. 138, 144.

effect of the bath is on the whole sedative to the nervous system. It comprises of course a direct effect on the nervous distribution in the skin, and an effect on and through the nervous centres. That the first effect, namely the influence on the *peripheral nervous system*, is of a sedative character, the observations of this bath in neuritis, local pains, cramps, etc., goes to show. The effect on the circulation is in striking contrast. There cannot be any doubt that the Peat Bath acts on the *peripheral circulation* as a powerful stimulant.

Baths of this character have been used and valued in medicine from ancient times. On the Continent of Europe, and particularly in Bohemia, they have been long employed; and in France, under the name of "Mincral Mud-Baths," being composed either of moor earth or the deposits from various mineral springs. No such baths appear, however, to have been used in this country until they were introduced at Strathpeffer in 1889. The following is a brief enumeration of the morbid conditions in which their employment has proved beneficial at the Scottish Spa.

1. *Disorders of the Peripheral Circulation.*—

These are at the root of many skin affections as well as more serious constitutional conditions. A chronic depression or defect of the blood supply to the surface of the body, with inactive skin and cold extremities, is commonly met with, and it is particularly in such cases that the Peat Bath is most efficacious.

2. *Gouty, Rheumatic, and Glandular* enlargements and exudations. The peat may be applied either in the form of poultices or baths.

3. *Painful Affections* of nerves, muscles, fibrous tissues, etc., more especially those connected with rheumatism and gout (*sciatica, lumbago, etc.*)

4. *Peripheral Neuritis*, from alcoholism or otherwise; "spinal irritation," and local sensory and motor disturbances more or less functional in origin.¹

In addition to the *Sulphur, Douche, and Peat Baths*, artificial *Brine Baths*, somewhat similar to those of Nauheim, are employed, with or without

¹ According to some recent researches on the Strathpeffer peat or moor earth, 1000 parts of the fresh peat yield 131·3 parts of dry material. When this has been ignited, the ash is found to be strongly alkaline and contains a considerable proportion of iron (Maxwell).

suitable exercises, in certain affections of the heart and circulation. The agreeable and aromatic *Pine Bath* is also given at Strathpeffer.

After any or all of these Baths the patient must *rest*. This part of the treatment is indeed of the greatest practical consequence, and is unfortunately often much overlooked. Hence sometimes the failure of bath treatment. Careful observations have shown that even the moderate exercise of dressing after the bath, and still more that of the gentlest walking, powerfully affect the condition of the patient, and alter at once his temperature and pulse rate. There can be no doubt that in very many cases a complete and long-continued rest after the bath is necessary in order to obtain the full effect of the treatment. A system of "porteurs" and sedans would materially contribute to this result.¹

¹ A variety of useful information, and many practical hints, will be found in *How to use the Baths*, 2nd ed. 1896, by J. Tregelles Fox, M.R.C.S. The reader may be also referred to the writer's paper, "Some Modes of Thermal Treatment at Strathpeffer Spa," *Lancet*, 1892, vol. ii. p. 219.

CHAPTER VII

HINTS UPON SPA LIFE AND DIET—THE SEASON MONTHS—THE “AFTER-CURE”—STRATH- PEFFER AS A WINTER RESORT

AMONG the restorative conditions of life at a Spa are embraced these four—the influence of Climate ; the use of Waters and Baths ; change in Manner of Life ; and suitable Dieting. Health-seekers can hardly escape the first of these, or overlook the second ; but the third and fourth are perhaps equally important, and these, unfortunately, it is very common to neglect. The Climate and Waters of Strathpeffer having been discussed elsewhere in this work, it remains to indicate very briefly some of the more essential points in Life and Diet which the invalid may properly observe.

Let him then in the first place accept the principle of *change*—it may be greater or less—in his habits and manner of living. Without this it is not possible for him to obtain the full measure of benefit ; but apart from this general truth, there are the greatest possible differences in individuals. Some persons are sunk so deep in unhealthy grooves that they need a complete revolution, not only physical but mental. In others it is sufficient to occupy the *mind* alone with something new. For this latter class, which is a large one, the Health Resorts of this country have not always hitherto made suitable provision. Many seeking renewal of health come from a life of mental labour and strain, and bring an overwrought mind with them. Such as these cannot sit on a cliff and look at the sea. The agency which is to “unbend the bow” must *possess* it and be exerted within it. Let such a one, if possible, bring friends with him ; or if not, condescend to make them. Let him enjoy good music, pleasant company, light literature ; or discover an interest in investigating the antiquities or natural curiosities of the district ; or, if strong enough, find pleasurable excitement in a little mountaineering.

Let the mind, by these and other means, be resolutely turned aside from the sensations of ill-health, importunate and peremptory though these may be. At the same time, let disturbing influences—business anxieties and the electric telegraph—be shut out for a season, and let the old and true warning be heeded—

“There is no cure for those who care.”

There is one particular in which change must be as thorough as possible. No man can rid himself of disorder without first ridding his life of the cause of his disorder. This applies in particular to meats and drinks, from which all ascertained causes of the present trouble must be rigidly excluded. Many who seek benefit obtain none from failing to conform to this rule.

Since only chronic affections are admissible to Mineral Water Treatment, the course of improvement, even in the most favourable circumstances, is usually gradual. *Perseverance* is therefore requisite in correcting, it may be, some slowly-acquired constitutional defect, like gout; or some defective state of absorption or nutrition, like

dyspepsia or eczema. Experience shows that such disorders do yield in a remarkable manner to sulphur water and baths, but it may be well, in a prolonged course, to intermit treatment for a while. Where decided benefit has been derived from a mineral water, it is matter of common prudence to repeat the treatment year by year, so long as it may be necessary.

Visitors at the Spa are enjoined not only to retire, but to *rise, early*. The first glass of sulphur water should be taken at least an hour and a half before breakfast, and in the open air, at the Wells. The cool, fresh, early hours of the summer's day or the crisp clear morning in October are to be tasted *out of doors*, with as much walking exercise as may be suitable to the case. This, as has been wittily remarked, greatly assists the digestion of the water, on the principle *solvitur ambulando*. After breakfast and a short rest, the invalid is encouraged, when the day is fine, to try another spell of *moderate exercise*. Although measured walks have not yet been marked out, any one may note for himself the increase of his excursion day by day—for example, on the hillside of

Kinettas. Even delicate and debilitated persons, and those suffering from organic weakness—for example, of the heart—are strongly advised to get daily upon the higher levels, north and south of the valley. For those who are a little more robust, there is the Golf Course and Knock Farril. But besides these, there are many who benefit by more vigorous exertion. Those accustomed to a sedentary or luxurious life will very often find that a long tramp upon the moors, or a little mountaineering or horse exercise daily, will greatly enhance the benefit of Mineral Water and Dietetic Treatment.

It is impossible to state any scheme of *Diet* applicable to all cases ; for, indeed, the regimen in this respect is very often a matter for most careful individual study. A few hints of a general character may, however, prove useful. *Be temperate* is the first law of health. Those who sit down to a prolonged *table d'hôte* may prudently remember the saying of Hesiod, "He is a fool who does not understand how much the half is better than the whole." Never eat unless hungry ; drink little or nothing with meals during the course of waters ;

take all meals in company, and eat slowly ; avoid all alcoholic stimulants. Whatever may be the case in ordinary life, there can be no doubt but that the majority of cases do better *at Spas* without alcohol. The few who persist, against advice, in habits of artificial stimulation, even in the free and healthful atmosphere of Spa life, generally discover to their cost that the course they have chosen has prevented any benefit they might have gained. On the other hand, there are conditions of ill-health, both at Spas and elsewhere, in which alcoholic remedies are very properly prescribed.

It is generally stated that the *Season* at Strathpeffer Spa extends from April or May to October ; but this division is an arbitrary one, and there is nothing to prevent the beneficial employment of both waters and baths at all periods of the year. The general climatic characters of the place are exhibited in the next chapter, but it may be useful to introduce in this place some practical notes on the meteorology of the several months, those at least in which visitors are accustomed to resort to the Spa.

It is to be observed that from April to August there is a period of comparatively small rainfall. *April* is the driest month of the year. Its temperature ($43^{\circ}8$) is one degree below that of October. There are usually a few night frosts (the average being five), and occasionally showers of snow with north-easterly or north-westerly winds. There are, however, many calm days, and much bright sunshine is recorded (average 160 hours). The percentage of the possible duration of sunshine rises higher in April than in any other month of the year, indicating a high degree of atmospheric purity.

May is nearly six degrees warmer than April, and is also a comparatively dry month, with clear skies. There is usually in this month a more or less prevalent easterly current, often very light, which occasionally fills the valley with white mists from the German Ocean. There are many fine summer-like days, with a cold shower now and then; and the sunshine record is very nearly as high as in June. The length of the northern days, nearly an hour longer than in London, becomes at this season very noticeable. The

cuckoo appears about the beginning, and the land-rail and swallow about the middle of May.

June in Scotland is perhaps of all the months the most favourable to invalids. The temperature (50°) is five degrees cooler than in London, but is at the same time less fluctuating, the daily range being small. Like the two preceding months, June is marked by a low degree of humidity. It is a dry month for Scotland, the average rainfall being less than two inches, and only exceeding that amount in three years out of eleven. The barometer is at its maximum in this month, and also the bright sunshine, which averages 178 hours. It is not a windy month, calm days prevailing, or a light easterly or north-westerly current. Snow occasionally still falls on the higher slopes of Ben Wyvis. A striking feature is now the almost total disappearance of the nights.

July is the warmest month of the year ($56^{\circ}3$); but at Strathpeffer, as elsewhere, the weather is often somewhat broken, with heavy showers. The rainfall is not, however, so high as in London. Westerly winds prevail, or calm, with occasional mists; and thunder, which is infrequent at Strath-

peffer, is most often heard in this month. Owing to the unsettled state of the atmosphere, the percentage of bright sunshine is somewhat low.

August to some extent resembles July in its general features. The temperature falls half a degree only. The rainfall generally is somewhat less, but August, like July, is apt to be showery.

In *September* a decidedly different meteorological character is exhibited. The mean temperature ($52^{\circ}3$) is three degrees colder than the previous month, but the weather is commonly more settled, and the average rainfall is decidedly less. The high percentage of bright sunshine marks out September from the two preceding months, and indicates that the atmosphere is relatively free from clouds and moisture. The cooler nights and increased terrestrial radiation often cause heavy dews to fall, and the early mornings are now sometimes full of indescribable freshness and fragrance, before the sun has taken up the mists from the hills. Westerly gales and some broken weather often occur about the end of the month.

October is not infrequently a fine month at Strathpeffer. There are in most years a few night

frosts towards the end of the month, and the mornings are often crisp and bracing, but the mean temperature is only a little below that of May. Among recent years, the October of 1888 was slightly warmer at Strathpeffer than at Greenwich. To the lover of clear skies, exquisite autumnal tints, and sunsets, this month in Scotland has great charms.

The period of the season at which treatment may be undertaken with most advantage must vary with the circumstances of the case. The author is accustomed to recommend invalids affected with rheumatic complaints to select, if possible, one of the early months ; for, if a moderate degree of cold is well borne, the comparative dryness of the spring or early summer enables the patient to be much in the open air. On the other hand, when cool temperatures are contra-indicated, Spa treatment should not be attempted before June, nor continued beyond the middle of September. Again, there is a large class of busy persons who cannot resort to baths and waters excepting in the autumn, when the annual interruption of business

or official or social routine takes place. Happily this is in most cases no disadvantage, for experience shows that Spa treatment at this season is productive of a powerfully alterative effect, and that in many cases it forms an admirable preparation for the winter. In particular, cases of obstinate eczema and other skin affections are often, in the writer's belief, more successfully treated in September and October than at any other period of the year.

When a full course of Waters, and more particularly of Baths, has been undergone, it is sometimes found desirable that the invalid should proceed to some other health resort, for bracing and change of air. This *After-cure*, so indispensable after a "course" at some of the Continental Spas, exposed to relaxing and oppressive heat, is applicable also to our own cooler and more northern stations. For by this means there is provided, before returning to the ordinary life, an *interval*, during which the functions that have been primarily affected by the treatment may recover their equilibrium, the nervous system may have rest, and general tonic influences may be brought to bear. Such an in-

terval is particularly desirable after the treatment by waters of rheumatic and gouty affections.

There is no lack of places to which the invalid may go on quitting Strathpeffer, but the choice in each case should be determined by medical considerations rather than mere preference. Sometimes a seaside and sometimes an inland station is more helpful. Among the former class, *Nairn*¹ takes a high place, with its dry climate and invigorating air; in the Black Isle² there are *Cromarty* and *Fortrose*, each with their special advantages; *Thurso* in the north; *Gairloch* and *Balmacarra* in the west; and on the southern road, *St. Andrews* and *North Berwick*. The inland resorts are valuable chiefly on account of their high elevation and pure air. They include *Bracmar* and *Ballater*, *Grantown* and *Kingussie*, *Killin* and *Alyth* in Perthshire, and many others.

A minute description of the *Winter Climate*, based upon observations extending over twelve

¹ See Dr. Brodie Cruikshank's valuable paper, "Nairn as a Health Resort," read before the Nairn Literary Institute.

² See Appendix: "Cromarty and the Black Isle."

winters, is given in the next chapter. The warmth of the nights, the bright sunshine of the days, and the freedom from mist and fog, are perhaps its most striking features.

It is important to remember that the character of greatest value in a winter health resort is not warmth, but pure dry air, bright sunshine, and perhaps the neighbourhood of mountains. If these be provided, it is well known that persons of great delicacy, and affected by serious pulmonary disease, rather benefit than otherwise by a certain amount of exposure to cold. At Davos Platz the night (minimum) temperatures for the winter months are *very far below* those of Strathpeffer; whilst, owing to the effects of bright sunshine, the day (maximum) temperatures are only slightly colder than the same readings at the Scottish resort. The difference between night and day—daily range—is, therefore, much greater at Davos than at Strathpeffer. The latter, indeed, has a remarkably *small daily range* for a sunny winter station.

Strathpeffer Spa, and several points in its immediate vicinity—Nairn, Forres, and the southern shores of the Black Isle—possess in a marked degree

the climatic qualifications belonging to a bracing WINTER HEALTH RESORT. There are numerous cases of pulmonary disease—some incipient, others recurrent or advancing—in which the gradual influence of Climate is certainly the most hopeful, and perhaps the only truly curative, treatment. Many of these invalids are able to take a certain amount of exercise, on foot or horseback, and are always the better for it. Where should such spend the winter? Rather than a moist relaxing climate, do they not need one more directly bracing, with dry sunny mountain air? If at the same time they are comfortably housed, encouraged to clothe warmly, live well, and avoid the occasional east winds of spring, experience has already shown in a striking manner that cases of this kind spend the winter at Strathpeffer with great benefit.

CHAPTER VIII

THE CLIMATE OF STRATHPEFFER SPA

NOTE.—The meteorological observations on which the following account of the climate of Strathpeffer Spa is founded were commenced by the writer in October 1884. They were subsequently undertaken, and are still continued, on a more ample scale, by his brother, J. Tregelles Fox, M.R.C.S. ; and at his instance Strathpeffer was made in December 1894 a Second-Order Station of the London Meteorological Office. I have to thank him for the free use of his observations, and for kind assistance in reducing the results of more recent years.

In a former edition of this work (1889) an interesting essay on the climate of Strathpeffer Spa was contributed by H. Courtenay Fox, M.R.C.S., late Fellow of the Royal Meteorological Society ; and I have, with his permission, incorporated a large part of it in the present chapter. See also a paper, with the same title, communicated by myself to the Royal Physical Society of Edinburgh in 1891.

The instruments used include a Symons' five-inch Rain-gauge, Negretti and Zambra's standard Maximum and Minimum registering Thermometers, the dry and wet bulb and solar radiation Thermometers, a mercurial Barometer of the Kew pattern, and a Campbell-Stokes Heliometer or Sun-recorder. The last named instrument was added in 1889. The height of the station is 257 feet above sea-level, and the latitude is $57^{\circ} 35' 30''$ N.

THE observer of natural configuration will often anticipate in some points the conclusions of the meteorologist. There are for each locality *prima facie* indications of its climate, more or less numerous and trustworthy. In the case of Strathpeffer there is first *proximity to the sea*, which approaches by the Cromarty Firth to between four and five miles. This must imply that both high and low temperatures will be subject to a powerful moderating influence at all seasons, tending to lessen the range of the thermometer. Next with regard to *situation* and *aspect*. Strathpeffer Spa lies in a rounded valley, running nearly east and west. On the north is the bulky mass of Ben Wyvis, rising to nearly 3500 feet. A narrow wooded ridge of 600 to 800 feet forms the southern wall of the valley. The western end is closed by hills, which at a few miles' distance rise to 2000 and 3000 feet, and extend in a broken formation across the country to the western coast. At the eastern extremity the Strath opens out, assumes its more typical form, and slopes down gradually to the sea.

By this configuration northerly winds are excluded, and those from the west and south-west,

often laden with rain, are obliged before reaching Strathpeffer to pass over a wide belt of hills. Hence there follows not only a certain mildness in the winters, but also a comparatively low rainfall. It is, moreover, obvious that the sharp ridge of hill to the south must cut off from the *southern* slope of the valley a proportion of the winter sunshine, having regard to the low altitude of the sun in this latitude. Furthermore, the undulating and rounded contour of the surrounding hills is another indication of moderate rainfall, for in very wet districts the hills are usually cut by the torrents into sharper outline.

Important and decisive inferences as to the climate may also be drawn from the *condition of vegetation*. In many other places a uniform deflection of the trees points to the prevalence of strong winds from one quarter. There is no such appearance at Strathpeffer. It will be noticed that trees and shrubs of various species, including some of the more delicate coniferæ and rhododendrons, thrive exceptionally well. From this it may safely be inferred that they enjoy both shelter and warmth, and, what is more, exemption

from extreme degrees of winter cold. The hill slopes in the vicinity of the Spa are now, to a great extent, covered with plantations of larch and fir. This must influence the night temperatures, from the well-known circumstance that the currents of cold air which pass down at night from the hills into the valleys are intercepted and warmed by intervening woods.

It will thus be evident that commonplace observation may properly supplement the use of instruments in the determination of climate. The most varied phenomena may indeed be utilised for this purpose. In addition to what has been already mentioned, observations on the flowering and fruiting of plants, on insect life, and on the appearance and migration of birds, are of considerable value.

It would be naturally supposed that since the latitude of Strathpeffer is nearly six degrees higher than that of London, the temperature would be generally cooler, the reduction being probably least in summer and greatest in winter, when the sun is near the horizon. In actual fact the summer at Strathpeffer is much cooler than in the south

of Britain, while, strange as it seems, the average winter temperature is very little lower than that of the neighbourhood of London, and some of the winter months have even been slightly warmer.

This result will not appear so surprising on considering the principal conditions which determine the climate of the north of Scotland. First, *the proximity of the sea*, which has been already referred to, tempers the extremes of heat and cold, tending to produce cool summers and warm winters, and a more equable climate. And, what is perhaps of greater consequence, the sea—especially on the *western* coast of Scotland—is maintained at a relatively high temperature by the constant flow of the warm equatorial currents. “During the winter months there is a constant excess of sea-temperature above that of the air, averaging 6°·2 Fahr., along the west coast of Scotland and its islands.”¹ The value of such a warm current in high latitudes is strikingly shown in the absence of ice in the harbours of Norway, even as far north as Hammerfest, through the whole winter.

¹ The late Dr. W. B. Carpenter.

Secondly, the *direction of the prevailing winds* is one of the most important elements of climate. Modern research has shown the frequent dependence of the weather upon extensive areas of low pressure, that successively approach from the Atlantic and pass over our islands in an easterly or north-easterly direction. The winds are found to blow around and in toward the centre of these depressions, and the direction of rotation is against the hands of a watch. The character of the weather at any moment depends upon the observer's position with regard to the central area of lowest pressure. If on the south side, the weather in winter is generally warm and 'wet,' with south-westerly winds. But when the centre itself lies to the southward, cold and bleak north-easterly winds prevail. The majority of these disturbances skirt our extreme northern coasts, and hence there is in winter a preponderance of south-westerly winds, accompanied by warm rains on the western slopes of the mountains. At the same time, the south of England is not unfrequently linked on to an area of high pressure (anti-cyclone) which brings cold, dull, foggy and frosty weather.

Thirdly, the *aqueous vapour* present in the atmosphere keeps the earth warm like a blanket at night, and prevents those sudden changes of temperature that are so hurtful to animal and vegetable life.

Fourthly, between Strathpeffer and the western coast rises a *mountainous table-land*, which not only breaks the force of the Atlantic gales, but robs them of a large proportion of their moisture.

The diagram which faces the title-page exhibits at a glance the mean value of some of the principal meteorological elements for each month, on the average of eleven to twelve years. The months are grouped into the usual meteorological seasons, and in order to give a complete view of the winter, an additional column is given to December. At the foot of the diagram the rainfall of Strathpeffer is compared with that of the Royal Observatory, which, it will be remembered, is situated in one of the driest districts in England. Occupying the middle portion of the diagram are three red curved lines, and three blue ones, showing, for Strathpeffer and Greenwich respectively, the average of the low night temperatures and of the high day

temperatures, and also the mean temperature of each month. The interval between the upper and lower curves is, therefore, a measure of the mean daily range, or the normal difference between night and day, which is so important in its relation to the public health. Lastly, at the upper part of the diagram are shown the mean monthly readings of the barometer, and the mean relative humidity.

TEMPERATURE

Table I. overleaf gives the principal temperature elements, the averages being calculated for the period beginning with November 1884.

The annual *Mean Temperature* of Strathpeffer Spa is $45^{\circ}\cdot 5$, that is to say $3\cdot 9$ degrees below that of London for the same period. Among the neighbouring meteorological stations, Culloden, about fifteen miles to the south-east of the Spa, has a mean temperature of $46^{\circ}\cdot 6$ ¹; Nairn $46^{\circ}\cdot 3$ ²; Dunrobin in Sutherlandshire $46^{\circ}\cdot 4$ ³; Wiek $45^{\circ}\cdot 3$ ²; Stornoway in the Island of Lewis $45^{\circ}\cdot 5$ ²; and Aberdeen $46^{\circ}\cdot 3$.²

¹ 1841-80.

² 1871-90.

³ 1857-80.

TABLE I

	Mean of Maxima.		Mean of Minima.		Mean Tempera- ture.	
	Strath- peffer.	Royal Obs.	Strath- peffer.	Royal Obs.	Strath- peffer.	Royal Obs.
January .	40°·4	41°·3	31°·8	32°·3	36°·1	36°·8
February .	42°·0	43°·6	32°·2	32°·6	37°·1	38°·1
March .	44°·2	49°·3	33°·1	33°·9	38°·7	41°·6
April .	50°·6	57°·1	37°·1	38°·3	43°·8	47°·7
May .	56°·0	64°·8	42°·5	43°·5	49°·3	54°·1
June .	62°·1	71°·6	47°·5	49°·8	54°·8	60°·7
July .	62°·6	73°·0	50°·0	52°·8	56°·3	62°·9
August .	61°·7	72°·1	49°·6	52°·3	55°·7	62°·2
September .	58°·2	67°·4	46°·4	48°·7	52°·3	58°·1
October .	50°·0	56°·0	39°·6	40°·8	44°·8	48°·4
November .	45°·1	49°·4	36°·4	38°·7	40°·8	44°·0
December .	41°·1	43°·0	32°·5	33°·8	36°·8	38°·4
Year .	...	...	...	...	45°·5	49°·4

It is possible that more extended observations will show a higher mean temperature for Strathpeffer, inasmuch as some recent years have been decidedly colder than the average. The warmest year of the series was 1893 (47°·7), and the coldest 1892 (43°·9).

The highest temperature in the shade was recorded on 30th June 1894, when the thermometer registered 80°·4, and the lowest was 8°·2 on

7th February 1895. The absolute highest and lowest readings in each year are given in Table II., in comparison with London.

TABLE II.—EXTREME TEMPERATURES

	Maxima.		Minima.	
	Strathpeffer.	Royal Observatory.	Strathpeffer.	Royal Observatory.
1885	75°0	90°2	12°0	22°3
1886	76°3	89°8	16°2	16°5
1887	79°8	92°2	19°0	15°5
1888	73°8	87°7	17°0	18°4
1889	76°0	86°6	19°5	18°7
1890	71°8	82°8	20°8	13°1
1891	73°6	85°1	17°8	12°0
1892	75°7	85°9	14°0	17°6
1893	78°7	95°1	13°6	13°9
1894	80°4	86°0	15°4	6°4
1895	76°8	87°3	8°2	6°9
Average	76·2	88·1	15·8	14·7

It is worthy of remark that in six out of eleven years the minimum was lower at the Royal Observatory than at Strathpeffer. The *mean* of the lowest readings is about one degree warmer at the northern station. On the other hand, the mean of the highest (summer) readings is 76° at Strath-

peffer against 88° in the neighbourhood of London. It follows that the *range* between the extreme temperatures of winter and summer averages about thirteen degrees less at Strathpeffer, and this difference is almost wholly due to the more temperate climate of the summers.

The difference between the two stations is much more marked by day than by night. The mean of the maxima for the three summer months is about ten degrees greater at the Royal Observatory than at Strathpeffer; but the mean of the minima for the same period shows a difference of not more than about $2^{\circ}5$. How are we to explain this greater relative coolness of the northern days? The lessened *altitude* of the sun will only account for a small fraction of the deficiency; neither can it be ascribed to an excess of *moisture* in the air, for the rainfall in summer is very little more than it is in London. In all probability the real cause is to be found in the cooling influence of the surrounding *sea*, coupled with the freer circulation of air upon a hillside. How marked is the contrast in the southern and mid-land counties of England, where an extensive

surface of land is daily exposed to a summer sun, and powerfully warms the air in contact with it!

The mean of the day temperatures (maxima) for the summer months severally and the mean of the night temperatures (minima) are given in the first table. The difference between these two elements represents the *mean daily range*, which is perhaps of more practical importance than the mean temperature itself. During June this mean daily range averages $14^{\circ}\cdot6$ (at Greenwich for the same month it is $21^{\circ}\cdot8$); in July $12^{\circ}\cdot6$ (Greenwich $20^{\circ}\cdot2$); in August $12^{\circ}\cdot1$ (Greenwich $19^{\circ}\cdot8$). It follows that the average difference between night and day temperatures for the summer is $13^{\circ}\cdot1$ at Strathpeffer against $20^{\circ}\cdot6$ in the vicinity of London. The comparatively small daily range in the northern summer is of course owing to the coolness of the days.

Grouping the months into the usual meteorological *Seasons*, we have the following results :—

TABLE III.—MEAN TEMPERATURE OF THE SEASONS

	Strath- peffer.	Royal Observa- tory.	Difference.
Winter (Dec. to Feb.)	36.7	37.8	— 1.1
Spring (Mar. to May)	43.9	47.8	— 3.9
Summer (June to Aug.)	55.6	61.9	— 6.3
Autumn (Sept. to Nov.)	46.0	50.2	— 4.2
Year	45.5	49.4	— 3.9

It is remarkable how closely the temperatures of the four months, December to March, approach to one another. The latter month is only about one degree warmer than February, whereas April shows an increase of five degrees over March. Temperature rises rapidly in the ensuing months—to its maximum in July; then declines very slightly in August, and more rapidly until the end of the year. The temperature of October ($44^{\circ}8$) nearly corresponds with that of the year, and the same remark applies to the Royal Observatory, on the average of a long course of years.

THE WINTER CLIMATE

It has been already observed that the summer at Strathpeffer is six or seven degrees cooler than

at Greenwich. The winter temperature presents a striking contrast, being on the average of twelve seasons just one degree cooler than at the Royal Observatory. The tendency, already noticed in the case of the summer months to a comparative warmth of the night and a small daily range, is still more marked in winter. This is shown in Table IV., which gives the average maximum, minimum, and mean temperatures for the winters 1884-85 to 1895-96.

It is a commonly received opinion that the night temperatures are of greater consequence in relation to health than the day temperatures. It appears from this table that the former (or *minima*) are on the average slightly lower than at Greenwich ($0^{\circ}7$), although in four out of twelve winters the night readings at Strathpeffer are slightly in excess. Taking the *maxima*, or day readings, there is a difference between the two stations of one degree in favour of London. This, however, is trifling in comparison with the ten degrees of difference in summer. The *mean temperature* of the winter (by which is always to be understood in this place the *arithmetical mean*) is $1^{\circ}1$ lower at Strathpeffer;

but in one winter it was exactly equal, and in two others Strathpeffer was warmer than London. It may be added that these figures apply to a comparatively short term of years, which happens to include several seasons notable for generally diffused low temperature.

TABLE IV.—WINTER TEMPERATURES

	Mean of the Minima.		Mean of the Maxima.		Mean Temperature.	
	Strathpeffer.	Royal Obs.	Strathpeffer.	Royal Obs.	Strathpeffer.	Royal Obs.
1884-85	31 ⁰ ·5	35 ⁰ ·8	38 ⁰ ·4	44 ⁰ ·9	35 ⁰ ·0	40 ⁰ ·3
1885-86	32·5	31·6	39·1	40·6	35·8	36·1
1886-87	32·1	31·4	41·5	42·3	36·8	36·8
1887-88	32·1	32·6	39·7	41·0	35·9	36·8
1888-89	34·0	33·2	43·0	43·4	38·5	38·3
1889-90	33·9	34·5	43·5	44·4	38·7	39·4
1890-91	32·9	28·7	42·9	39·4	37·9	34·0
1891-92	31·0	33·6	40·2	43·9	35·6	38·7
1892-93	30·9	33·0	40·1	42·4	35·5	37·7
1893-94	33·0	34·5	42·4	45·2	37·7	39·8
1894-95	28·0	29·9	38·7	39·7	33·5	34·8
1895-96	34·3	35·6	44·2	44·7	39·5	40·1
Average	32·2	32·9	41·6	42·6	36·7	37·8

TABLE V.—WINTER MEAN TEMPERATURES

Sumburgh Head, Shetland . . .	38°·9
Stornoway, Isle of Lewis . . .	38·9
Wick	37·9
Culloden (1841-80)	38·0
Nairn	37·8
Aberdeen	37·9
Leith	39·3
York	38·1
Cambridge	38·0
Royal Observatory, Greenwich . .	39·5

Table V. shows the general distribution of winter temperature derived from readings extending over a longer period, all, with the exception of Culloden, being taken from the *Daily Weather Report* of the Meteorological Office, and applying to the twenty years 1871-90. How unimportant appears to be the practical effect of difference of latitude; for one may expect to find a rather warmer winter in the Hebrides than at Cambridge or York!

The north of Scotland is frequently unaffected by the long spells of cold on the Continent of Europe. How much this exemption may be attributed to oceanic currents, and how much to the proximity of cyclones, and the consequent

prevalence of westerly or south - westerly winds, has yet to be determined.

An important matter in considering a Winter Climate is the *frequency of Frosts*, and their *intensity*. Winter frosts have been conveniently distinguished by H. Courtenay Fox, M.R.C.S., as follows. First, *Night Frost*, where the temperature of the air at some period of the twenty-four hours falls to 32° or less ; -secondly, *Mean-Frost*, in which the mean temperature of the day and night, taken together, is at or below 32° ; thirdly, a still colder form, the *Entire Frost*, in which the frost persists throughout the entire day, that is to say, the maximum does not rise above 32° .

The frequency with which *Night Frosts* have occurred at Strathpeffer has varied from 32 to 59 ; the average of twelve winters (December to February) is 45, which is only slightly in excess of the corresponding number for the Royal Observatory. *Mean Frosts* have varied from 38 in the cold winter of 1894-95, down to only 5 in that of 1895-96. Their average is about 22, and they tend to be distributed in nearly equal proportions over the three winter months. At the Royal

Observatory their numbers have varied from 35 in the winter of 1890-91 down to only 4 in that of 1895-96. Their average is 18, and a large proportion of them occurred in January. Turning now to the *Entire Frosts*,¹ we find they have varied at Strathpeffer from 0 to 13 ; the average of the twelve winters being between 5 and 6. At Greenwich the entire frosts varied from 0 to as many as 25, the average of twelve winters amounting to between 6 and 7. This excess is mainly to be attributed to two recent winters, which were felt with greater severity in England than in Scotland.

A few remarks on the winter months individually may be of interest.

December is the period of lowest barometer and greatest rainfall, with frequent strong south-westerly winds. Different Decembers have varied much in temperature ; the coldest, in 1886, being $32^{\circ}\cdot8$, and the warmest, in 1893, $40^{\circ}\cdot3$. One December was slightly warmer at Strathpeffer than at Greenwich.

¹ An entire frost is always reckoned among the mean frosts ; for it is a mean frost, and something more.

In *January* we find the barometer not so low as in December, and there is some abatement of the rainfall. The temperature is curiously variable, ranging from $32^{\circ}9$ in 1885 to as much as $40^{\circ}2$ in 1889, when it was actually $0^{\circ}9$ *warmer than Hastings!* It is a somewhat windy month, with occasional spells of north-easterly and north-westerly winds. Four Januaries were from $0^{\circ}7$ to $3^{\circ}1$ *warmer than at the Royal Observatory*, and in a fifth the temperatures at the two stations were equal. The writer has found violets, stock, and polyanthus blossoming out of doors early in January, and shortly afterwards snowdrops, the japonica, and yellow jasmine.

Of *February* it may be said—

“Now shifting gales with milder influence blow;
Cloud o’er the skies, and melt the falling snow;
The softened earth with fertile moisture teems,
And, freed from icy bounds, down rush the swelling streams.”

The days begin rapidly to lengthen, and the great charm of this month probably consists in the frequent bright sunshine, which gladdens the heart of Nature, and inspires the beholder with new life and fresh hopes. In February the days are a little

warmer, but, as the nights are nearly as cold, the mean temperature is only one degree warmer than in January. Four Februaries were rather warmer at Strathpeffer than at Greenwich; in two others the temperatures were nearly equal at both stations.

Though *March* is not technically a winter month, yet its temperature is only 1·6 degrees above that of February. The drier air and clearer skies of this month admit of the not infrequent enjoyment of bright and genial sunshine, and occasionally a stray butterfly makes a brief appearance about the middle of the month. The record of bright sunshine,¹ which gives an average total of 68 hours in February, rises rapidly in March to just 120 hours. At the same time the occasional prevalence of dry easterly winds, and the freer nocturnal radiation, check the natural rise of temperature, and give to this attractive month a certain harshness, go where you will. Fine displays of the *Aurora borealis* are often seen about the end of this month.

The comparative freedom from mist and fog, for which Strathpeffer is indebted to the friendly

¹ *Vide infra*, Table IX.

shelter of the western mountains, is one of the agreeable features of the winter ; and together with the purity of the air, it contributes to the remarkable brightness of the sunshine, which almost redeems the comparative shortness of the day.

RAINFALL

No element of a climate is more dependent on the natural configuration of a locality than rainfall. A writer in 1772¹ correctly attributes the comparatively low rainfall of the immediate vicinity of the Spa to the screen of hilly country lying to the west. "It is worth while remarking," he says, "that the western mountains make the weather alternately foul and fair on the east and west borders of them, in some measure similar to the monsoons on the Malabar and Coromandel coasts. The west and south-west winds blow most frequently, during which it generally rains on the west coast and is fair weather on this side of the hills, or at most there are only slight occasional showers. On the other hand, the east wind uniformly [?] brings rain or sleet on the east coast, but the storm dies

¹ *Statistical Account of Scotland*, vol. vii. p. 247.

away in the intermediate hills, and there is dry weather and sunshine on the west coast."

On the average of the eleven years 1885-95 the rainfall of Strathpeffer is 30·99 inches. This nearly but not quite falls within Mr. G. J. Symons' second lowest grade, from 30 to 25 inches, the first or lowest being less than 25 inches. The area of lowest rainfall includes a considerable portion of the eastern half of England, and some districts on the east coast of Scotland north and south of the Moray Firth. Strathpeffer Spa is at the border of one of these limited dry areas, at the junction of low with considerably higher rainfalls. At the distance of a very few miles among the hills to the west of the Spa the precipitation is nearly doubled, and forty miles across the country at the west coast (Strome Ferry) it is more than doubled.

It will be observed that the heaviest rainfalls occur where the south-west winds are opposed in their course by high mountain masses, as in the Northern Highlands, the Lake District of Cumberland, and in North and South Wales. The wettest place in Scotland appears to be Glencoe, in Argyll, where the mean of six years, ending in 1870, was

TABLE VI.—RAINFALL, MEAN TEMPERATURE AND BRIGHT SUNSHINE

STATION.	Annual Rainfall.		Annual Mean Temperature.		Annual Bright Sunshine.	
	Inches.	Years.	Degrees.	Years.	Hours.	Years.
Sumburgh Head, Shetland	36.90	1871-90	44.6	1871-90	[1145] ¹	1881-90
Stornoway, Lewis . . .	47.22	1855-90	45.5	1871-90	1231	1881-90
Strome Ferry . . .	65.30	1872-83	...	...	...	...
Dunrobin, Sutherland . .	30.08	1860-83	46.4	1857-80	...	...
Invergordon, Easter Ross .	27.26	1865-83	[46.5 ²]	?	...	...
Strathpeffer Spa . . .	30.99	1885-95	45.5	1885-95	1246	1890-95
Culloden, Inverness . . .	26.17	1860-83	46.6	1841-80	...	...
Nairn . . .	24.26	1866-90	46.3	1871-90	...	...
Braemar . . .	33.43	1885-95	42.9	1885-95	1181	1890-95
Aberdeen . . .	30.94	1866-90	46.3	1871-90	1394	1881-90
Edinburgh . . .	27.08	1885-94	47.1	?	1225	?
Glasgow . . .	43.00	1860-83	47.4	?	1057	1881-90
Grasmere . . .	82.80	1866-83	...	...	...	...
The Styre, Cumberland . .	185.96	1866-83	...	...	...	...
Scarborough . . .	27.50	1881-90	47.5	1881-90	...	...
Harrogate . . .	28.89	1885-95	...	...	[1223] ³	1881-90

¹ Recorded at *Sandwick* (Orkney).² *Cromarty*.³ *York*.

TABLE VI.—*Contd.*—RAINFALL, MEAN TEMPERATURE AND BRIGHT SUNSHINE

STATION.	Annual Rainfall.		Annual Mean Temperature.		Annual Bright Sunshine.	
	Inches.	Years.	Degrees.	Years.	Hours.	Years.
Buxton	46·42	1885-95	44·7	1881-90	1020	1882-90
Leamington	22·61	1885-95	...	...	...	...
Droitwich	24·13	1885-95	...	...	...	...
Bath	30·60	1885-94	...	...	...	...
Beddgelert, Carnarvon .	115·08	1860-79	...	...	...	...
Royal Observ., Greenwich	23·22	1885-95	49·4	1885-95	1247	1890-95
Margate	23·31	1881-90	49·2	1881-90	...	...
St. Leonards	29·42	1885-95	50·1	1871-90	1712	1883-90
Brighton.	28·75	1881-90	50·0	1881-90	...	...
Ventnor	28·92	1885-95	50·8	1881-90	1638	1885-90
Bournemouth	29·19	1885-95	[50·1] ¹	1871-90	...	...
Ilfracombe	30·63	1881-90	51·1	1881-90	...	...
Torquay	34·14	1885-95	...	...	...	...
Falmouth	47·44	1871-95	50·5	1871-95	1736	1881-95
Guernsey	32·53	1881-90	51·5	1881-90	[1865] ²	1881-90
Killarney	57·10	1881-90	49·0	1881-90	...	...

¹ *Hurst Castle.*² *Jersey.*

128·50 inches. Even this, however, sinks into relative insignificance compared with The Styne, in Cumberland, reputed to be the wettest place in the three kingdoms, where the rainfall for twelve years was at the rate of $15\frac{1}{2}$ feet per annum.

Table VI. gives, among other elements, the annual rainfall of several Scottish stations, and some of the better known English Spas and health resorts.

Starting from the south-east of England, where the rainfall is least, there is, on travelling either westward or northward, a marked increase of precipitation. Again, how striking is the contrast between the eastern and western coasts of Scotland! Whilst the rainfall of Nairn is as low as 24 inches, that of Edinburgh is about 27 inches, and that of Strathpeffer and Dunrobin 30 inches; Glasgow has an annual fall of 43 inches, and Strome Ferry of 65 inches.

The *seasonal distribution* of the rainfall, and the number of *rainy days* on the average of eleven to twelve years, are given in Table VII.¹

¹ A fall of at least one-hundredth of an inch of rain (or its equivalent in snow) is understood to constitute a "rainy day."

TABLE VII.—DISTRIBUTION OF RAINFALL

	Mean Rain- fall at Strathpeffer.	Mean Number of Rainy Days.
	Inches.	
January . . .	3·08	19
February . . .	2·64	17
March . . .	2·55	17
April . . .	1·58	14
May . . .	1·99	17
June . . .	1·77	13
July . . .	2·90	19
August . . .	2·77	20
September . . .	2·22	18
October . . .	3·09	19
November . . .	3·09	17
December . . .	3·35	19
Year . . .	30·99	209

The driest year of the series was 1887 (26·36 inches), and the wettest 1895 (36·46 inches). Exactly one-half the annual rainfall occurs in the five months October to February, and December is the wettest month of the year, with 3·35 inches. The period of lowest rainfall comprises the three

But as it often happens that the rain falls *in the night*, leaving the hours of daylight clear, we have carefully to distinguish between the scientific and the popular acceptance of this somewhat misleading term.

months April, May, and June, April being so far the driest month of the year.

As in London, so at Strathpeffer, there is a distinct tendency to increased precipitation in July, which subsides in the two following months, and is thus marked off from the autumnal rainy period. It was shrewdly observed long ago, by Luke Howard, the father of modern Meteorology, that the *estival* rains are of different origin and character from the *autumnal*. The former occur in the hottest part of the year, which partakes in a slight degree "in the operation of the same causes which produce the heavy tropical rains." There is a relatively high barometer; the air is comparatively clear and calm; there are light and variable breezes, and the rain is precipitated in the more elevated regions, and falls through relatively dry air. The autumnal rains, on the other hand, are due to the prevailing warm south-westerly current, which gathers moisture as it sweeps over the Atlantic, to discharge it upon our colder latitudes. Hence there is, not only frequent rainfall, but a prevailing "turbidity" or moistness of the atmosphere, in those places that have not

the advantage, possessed by Strathpeffer, of a screen of mountains to windward.

The rainfall measured in one month amounted to five inches or upwards on five occasions—in January, February, July, October, and November, the wettest month on record being February 1894, when 6·32 inches were registered. On the other hand, the monthly rainfall fell short of one inch on thirteen occasions, three times each in April and June, twice in September, and once each in February, May, July, August, and December. The driest month of the series was September 1895, when the amount was very nearly a quarter of an inch. The months in which the amount of rain varies least from year to year are May, April, and March, whilst October and July are the most variable. Finally, the Strathpeffer records indicate that whilst July is usually a little drier than in London, the rainfall of the five spring and summer months (April to August) taken together approximates very closely to that of the metropolis.

HUMIDITY

The relative humidity for the seven years 1889-95, calculated from the daily readings of the wet and dry bulb thermometers, is represented in the diagram by a curved line. The three months April, May, and June form a period of least atmospheric moisture, and the air is driest in June, in which month the humidity falls to 76, saturation being expressed by the figure 100. The relative humidity for the entire year averages 83·5 against 81 at Greenwich.

PRESSURE OF THE ATMOSPHERE

The barometrie curve, represented in the diagram, indicates a distinct maximum in June, which is, next to April, the driest month. The mercury usually falls somewhat in July; the mean monthly readings then remain fairly level for the next two months, after which they fall quickly to their lowest value in December, which is the wettest month. A partial recovery of pressure takes place in January and February; the mean values continue without much change

throughout the spring, and then rise sharply, to return to the maximum in June. The difference between the average height of the barometer in this month and in December is 0·33 inch. The months in which there is least variation from year to year in the mean readings are June and July, whilst the annual variation is more considerable for September and the winter months.

The mean monthly *range* of the barometer is considerably greater in every month than is the case in London, and this is just what would be expected from its more exposed situation. At both places the range is greatest from November to January, and is least in June and July. It seems to be a general rule that a wide range accompanies low pressure, and a small range—in other words, greater *steadiness*—is associated with high readings of the barometer.

SOLAR RADIATION

It remains to give some account of the solar radiation at Strathpeffer Spa, and a brief reference to the influence of *latitude* may suitably introduce this portion of the subject.

The latitude of a given place, though only one of many factors that combine to form what we term its *climate*, must exercise an influence of no small importance, for upon it depend the length of the day and the altitude of the sun. Differences of latitude are therefore the immediate cause of corresponding differences in both the duration and intensity of sunshine. By the word *sunshine* must be here understood the total solar radiation, visible and invisible, in all its properties—luminous, thermal, chemical, electrical, and otherwise. In the same manner by the term *transparency*, as applied to the atmosphere, is signified its permeability to all these forms of energy.

Table VIII., for which the author is indebted to the kindness of a meteorological friend, gives the comparative values of solar radiation at Strathpeffer and Greenwich. The light, heat, etc., received from the sun moment by moment during the day (*excluding the effects of atmospheric absorption*), are here expressed in terms of the number of seconds that he would require to shine *in the zenith*, in order to give an equal amount of radiation. It follows from this table that in

summer the greater length of the day in the more northern station, due to the sun's more oblique course through the heavens, nearly compensates the loss of solar radiation involved in his lower altitude; whilst in midwinter, on the contrary, the lower altitude and shorter day combine to reduce the ideal radiation to nearly one-half the amount at London.

TABLE VIII

	Zenith Solar Seconds.		Length of Day.	
	In Seconds.	Hours and Minutes.		
Winter Solstice—		H. M.	H. M.	
Strathpeffer . . .	2,340	0 39	6 17	
Greenwich . . .	4,620	1 17	7 36	
Equinox—				
Strathpeffer . . .	14,760	4 6	12 0	
Greenwich . . .	17,100	4 45	12 0	
Summer Solstice—				
Strathpeffer . . .	31,320	8 42	17 43	
Greenwich . . .	31,560	8 46	16 24	

If the surface of the earth were smooth and homogeneous, and there were neither sea nor air upon it, it would be a comparatively simple matter

to assign the climate of each parallel of latitude by ascertaining the zenith solar seconds proper to that parallel. We have, however, already seen how powerfully both temperature and rainfall are affected by causes independent of latitude, by proximity of sea or of mountains, by oceanic currents and currents in the atmosphere, or winds. These influences may be so strong as to compensate the effects of diminished solar radiation, and give to a northerly station, such as Stornoway, the same degree of warmth as is enjoyed by places many hundreds of miles farther south.

There is, however, another powerful factor of climate which directly governs the available solar radiation, and affects its amount no less surely than the degree of latitude. This is the *state of the atmosphere*, in respect to its transparency for the solar rays. This transparency varies within very wide limits in different places and at different seasons; and it is the condition of the atmosphere at any station at a given time that practically determines the amount of radiation enjoyed.

Table IX. shows the sunshine records for Strathpeffer Spa for the period from December

1889 to February 1896, in comparison with the records of the Royal Observatory, Greenwich, and the Meteorological Office at Westminster, both for

TABLE IX.—BRIGHT SUNSHINE

	Average duration of Bright Sunshine in hours.			Percentage of the possible duration.		
	Strath- peffer.	Royal Obs.	West- minster.	Strath- peffer.	Royal Obs.	West- minster.
January . .	33·7	28·8	24·8	15·0	11·0	9·5
February . .	68·0	54·5	37·2	25·2	19·5	13·5
March . .	119·8	105·7	91·3	33·4	28·0	24·9
April . .	159·8	148·8	133·2	38·2	35·9	32·1
May . .	172·0	179·5	175·6	34·4	37·4	36·6
June . .	178·0	165·2	175·9	33·2	33·3	35·5
July . .	120·5	141·8	154·5	22·0	28·5	31·1
August . .	113·4	153·3	169·1	24·2	34·0	37·6
September . .	114·4	136·0	132·9	30·8	36·0	35·1
October . .	86·7	79·3	78·6	28·2	24·1	23·9
November . .	49·1	39·3	32·8	21·1	14·8	12·4
December . .	29·4	15·5	15·6	14·9	6·4	6·4
Year . . .	1246	1247	1221	26·9	25·8	24·9

the years 1890-95. The right-hand columns exhibit the percentage of the possible duration, calculated from the average length of the day at each station. It will be observed that the maximum of bright sunshine at Strathpeffer is in June, but that May

is very nearly as bright. The highest percentage is, however, found in April; and the figures indicate that all the spring months with June and September enjoy a high degree of atmospheric transparency.¹ The highest record for any one month was 203·8 hours in June 1891, and the brightest year of the series was 1892 with 1310 hours.

It should be stated that the radiation records at Strathpeffer are necessarily checked by the hilly contour of the valley. There is a wall of 500 to 700 feet on the south, which brings about a premature sunset in midwinter; whilst on the north-west of the Spa, hills of from 1000 to 1500 feet cut off from the northern side of the valley, where the instruments are mounted, all sunshine after about 6.30 P.M.; although very frequently the south side of the valley remains in brilliant sunshine as late as eight o'clock on a summer's evening. It should be borne in mind that *aspect*, on a slope facing south or south-west, will compensate, in some degree, for the obliquity of the sun's rays.

¹ Some further remarks on the meteorology of the "season months" will be found in the preceding chapter.

TABLE X.—SUNSHINE OF THE SEASONS

	Hours of Sunshine.			Percentage of the possible duration.		
	Strathpeffer.	Royal Obs.	Westminster.	Strathpeffer.	Royal Obs.	Westminster.
Winter (Dec. to Feb.)	131·1	98·8	77·6	18·4	12·3	9·8
Spring (Mar. to May)	452·0	434·0	400·1	35·3	33·8	31·2
Summer (June to Aug.)	412·0	460·3	499·5	26·5	31·9	34·7
Autumn (Sept. to Nov.)	250·2	254·6	244·3	26·7	24·9	23·8

The *seasonal distribution* of sunshine at Strathpeffer is given in Table X. in comparison with the two metropolitan stations. *Spring* is marked by a high percentage of sunshine, that is by an exceptionally clear atmosphere; and when the months are considered severally, it will be observed that each of the four months from March to June exhibits a record of at least one-third of the possible sunshine. Doubtless still more would be registered if the shadow of the hills did not fall upon the instrument. In the later *summer* months the percentage declines, and indeed falls below that of the Royal Observatory. In *autumn* the

proportion again increases, and shows a decided excess over the southern stations in October and November. Lastly, it is noticeable that the three *winter* months have an average total of 131 hours against 77 in London.

In comparing the records of different localities with a view to estimating the atmospheric state of each, a correction must be introduced for differences in the depth of atmosphere traversed. At Strathpeffer, for example, the solar rays, coming obliquely from their source at a comparatively low altitude, traverse a wider belt of atmosphere than is the case farther south. It follows that *the same percentage of sunshine implies a greater transparency of the atmosphere the farther north it is recorded*; that is, the longer and more oblique its course through the aerial envelope of our planet. Reverting to Table X., it will be seen that at Strathpeffer and Westminster the winter percentages of possible duration of sunshine are respectively 18·4 and 9·8, or nearly as two to one. When, in addition to this, one takes account of the difference arising from the greater depth of atmosphere traversed at the more northerly station, it

follows that in winter the transparency, and therefore the purity, of the air are probably at least three times greater at the Spa than in London.

In conclusion, so far as experience at present extends, Strathpeffer may be said to enjoy a temperate and fairly equable climate, combining some of the advantages both of sea and mountain, at the same time that it is to a large extent free from the drawbacks that accompany a situation too exclusively of one kind or the other.

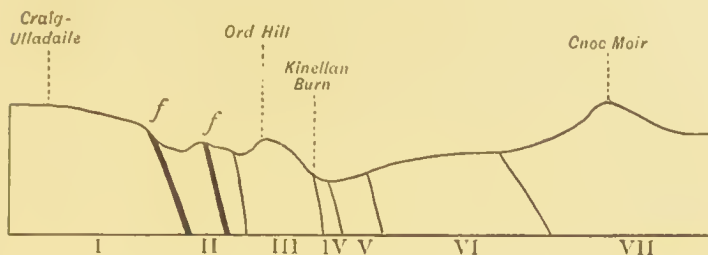
CHAPTER IX

GEOLOGY AND BOTANY

(1) GEOLOGY

STRATHPEFFER is situated on the *Old Red Sandstone* beds, a geologic formation laid down in inland seas abounding in life. The larger hills, Ben Wyvis to the north, and the mountains of Ross to the west, are composed of the more ancient *Primary Rocks*—Gneiss (whinstone), with Mica and Quartz.

The late Mr. Miller of H.M. Geological Survey, who worthily sustained the great traditions of his name, made some years since a minute examination of the geology of Strathpeffer, and constructed a section map, which is here reproduced in a rough diagrammatic form.



- | | |
|--|--|
| I. Quartzose and micaceous rock—gneiss. | IV. The Spa beds—fetid calcareous shales (bituminous), with limestone bands. |
| II. Lower sandstone, yellow, with conglomerates. | V. Olive shales. |
| III. The Ord Hill beds—fetid calcareous rocks, with some olive shales. | VI. Red shales, passing up into sandstone. |
| | VII. Knock Farril—coarse conglomerate. |
| | <i>ff.</i> Faults. |

It represents the outcrop of the various rocks in the hollow of the Strathpeffer valley. The sulphur-yielding clay-slates, or shales (IV.), make their appearance in the immediate vicinity of the Kinellan burn in the bottom of the hollow, where they have been exposed by the constant action of running water. The diagram shows that from Craig Ulladaile, north-west of the Spa, eastwards to the Cat's Back and North Farril, the beds of the "Old Red" appear in ascending order—that is, those nearer the earth's surface to the eastward—forming parallel strips at the outcrop, with

a general dip E.S.E. *Conglomerate* caps the series, forming a sharp ridge or knife-edge south of the valley, and terminated by the two abrupt summits known as Knoek Farril and the Cat's Baek. On the south aspect of the last-named hill, the cliffs of Brahan, with the broken masses at their base, admirably exhibit the pudding-like formation of this rock. To the west, the limit of the conglomerate formation extends as far as Tor Aehilty. It is well exposed in the precipitous eastern face of this hill.

Beyond this point even the outlines of the country testify to a different geological structure. Mr. W. Hamilton Bell thus describes the prospect from the View Rock, about two miles west of the Spa :—
“ You see the flat rolling hills of the gneiss in the Seatwell Hills to the south-west, and Ben Wyvis with his huge mass and elevation of 3500 feet in the north ; the latter a true gneiss mountain, with breadth of shoulders and amplitude of base enough to serve a mountain thrice as tall ; but which, like all its congeners of this ancient formation, was arrested in its second stage of growth. Farther west, the mica hills of Seuir Vuillin and

Scur-na-Vertach are seen, with their high sharp-peaked cones of 2500 feet, so typical of that formation ; while in the far west rise the steep hills on the west side of Loch Carron with their abrupt but square tops of the quartz, and the red and purple stones of Applecross ; and again to the east the low-lying Old Red of the Black Isle running along the south side of the Cromarty Firth." He goes on to recommend, as full of geological interest, the walk, about three miles, across the hills from the View Rock to the Dingwall and Skye Railway :—"The ground is not difficult, the rocks are mostly mica, which appears everywhere, and the formation is very well displayed both as to constituents and stratification, the dip and strike being almost everywhere well shown. The rocks themselves are well worth observation, being the Muscovite Mica in large masses and nodules, mixed with the largest amount of garnets I have ever seen ; and at and near the Glenskiagh Cutting, the display of this most beautiful rock is quite wonderful."

The strata from which the Sulphur Waters take their origin appear in the bottom of the Strath-

peffer valley. They vary in density and appearance from a loose brownish *shale* to a compact rock, or *breccia*, but all varieties are impregnated with a peculiar bituminous matter, and emit on fracture a somewhat fetid odour of sulphuretted hydrogen. The celebrated Hugh Miller (*père*), to whom all this district was familiar ground, thus describes the Strathpeffer rock:—"It lies over that conglomerate member of the system which, rising high in the Knoek Farril range, forms the southern boundary of the valley and occupies the place of the lower ichthyolitic bed, so rich in organisms in various other parts of the country. But here the bed" [Sulphur-yielding Shales], "after it had been deposited in thin horizontal laminae, and had hardened into stone, seems to have been broken up by some violent movement into minute sharpened fragments, that, without wear or attrition, were again consolidated into the *breccia* which it now forms. And its ichthyolites, if not previously absorbed, were probably destroyed in the convulsion. Detached scales and spines, however, if carefully sought for in the various openings of the valley, might still be found in the original

laminae of the fragments." [Mr. Miller himself found none.] "They must have been amazingly abundant in it once, for so largely saturated is the rock with the organic matter into which they have been resolved, that when struck by the hammer, the impalpable dust set loose sensibly affects the organs of taste and appeals very strongly to those of smell. It is through this saturated rock that the mineral springs take their course." And again :—
"The thorough identity of the powerful effluvium that fills the Pump Room with that of the muddy sea-bottom, laid bare in summer weather by the tide, is to the dweller on the sea-coast very striking. It is identity, not mere resemblance. Here, in smell at least, that ancient mud, swam over by the *Diplopterus* and *Diplacanthus*, and in which the *Coccosteus* and *Pterichthys* burrowed, has undergone no change. The soft ooze has become solid rock, but its odoriferous qualities have remained unaltered." ¹

This theory of a "violent movement" of the strata is supported by evidences of upheaval along the northern side of the valley. Even the great

¹ *Rambles of a Geologist*, p. 373.

fissure of the Raven Rock is regarded by some as a vast rent, with downthrow to the north, whilst others maintain it was cut out by water. But there are undoubted geologic "faults," observing the same direction, in the conglomerate near Dingwall, and most remarkable of all—the chasm known as the "Black Rock" at Evanton. This occurs in the same formation, and is by most geologists also regarded as a fault.¹

The bituminous substance already mentioned as occurring in the Strathpeffer shales was long since observed, and described as a thin vein of coal-like material at the back of Castle Leod. The vein was, indeed, worked more than once, and the masses of black, highly-combustible mineral—now

¹ In all probability this fissure has been caused by "a fault in the conglomerate, similar to many of those faults which, in the coal measures of the southern districts, we find occupied by the trap. But, in this northern district, where traps are unknown, it must have been filled up by the boulder clay or some still more ancient accumulation of débris. And, when the land had risen, and the streams, swollen into rivers, flowed along the hollows which they now occupy, the loose rubbish would in the lapse of ages gradually wash downwards to the sea, as the stones thrown from the fields above were washed downwards in a later time; and thus the deep fissure would ultimately be cleared out."—Hugh Miller, *op. cit.* See also Appendix: "Black Rock."

known as *albertite*—used for fuel. Much geological interest has been excited by the discovery that the vein of albertite occupies a narrow fissure in the primary rock. The subject has been investigated by Mr. Morrison, late of the Dingwall Academy.¹ He places albertite between coal and asphalte; and, in spite of its occasional occurrence, as at Castle Leod, in the gneissose rock, refers it to the Old Red Sandstone. According to this authority, its presence in both formations is due to a fusion of the albertite by heat, developed during the contortion and compression of the rocks. The bituminous fluid would thus be driven, under pressure, into cracks and fissures in the *under-lying*, as well as the *over-lying*, strata. On the banks of the Skiach burn on Ben Wyvis albertite may be picked up as small lustrous jetty fragments. In the Spa shales it takes the form of a thin glossy black scale, or layer, adherent to the rock. It is regarded, in each case, as “formed by a process of dry distillation from the bituminous fish-bearing flags of the Old Red.”

Another object of interest in the Spa shales is

¹ *Trans. Edinb. Geol. Soc.* 1884.

the nugget or nut of iron pyrites (sulphuret of iron). These nuggets, bright and metallic-looking in appearance, are frequently met with in the neighbourhood of the Wells. The iron sulphuret is a result of some bygone decomposition of organic matter, probably to a large extent of vegetable origin; and is now yielding, under aqueous action, its medicinal properties to the Strathpeffer Waters.

The soil in the lower part of the Strath is alluvial and of great fertility. It is in this, geologically the *most recent* deposit, that one finds the flint arrow-heads and other relics of prehistoric Man.

The marks of *Glacial Action* are plentiful around Strathpeffer. Very pronounced scoring and polishing of the rocks may be seen, for example, on the roadside by Rogie Falls, and also a little short of Garve. Glacier drifts abound, some good specimens occurring between Loch Achilty and Little Scatwell. Wandered boulders, dropped from huge ice-floes when the country was more or less submerged, are met with in all situations, testifying by their alien structure to

the remoteness of their origin. In some places the ancient presence of a water line is indicated by *Raised Terraces*, or *Beaches*. These consist of level banks of water-rolled pebbles and sand. Some fine examples occur between Rogie and Contin, beside the Blackwater; and they are seen in great perfection near Auchnasheen and on Loch Carron.

The lover of minerals may enjoy "a happy hunting-ground" in the railway cuttings near the Raven Rock and in the adjacent quarry. He will here find fine specimens of *mica* (muscovite) and beautiful *garnets* and *tourmaline*. Near Garve the rare *epidote* occurs on the left-hand side of the road, and *zoisite* in a vein of quartz on the hillside not far from the station.

(2) BOTANY

The most important influence affecting the flora of a district is undoubtedly *Climate*. In the case of Strathpeffer the presence of mountains and valleys, and the proximity of sea, impart to it a semi-alpine and semi-maritime character; whilst

the low rainfall (for a mountainous district) does not admit of that green wealth of foliage and ferns and mosses, characteristic of some of the Western Islands and of the English Lakes. For moist habitats one must here go to the most sheltered woods, and to the rocky dells and corries of the hills, but in these a variety of ferns and many exquisite mosses abound. The sides of Ben Wyvis and Scur Mairc exhibit, like a miniature Switzerland, the peculiar features of the flora of higher levels—tufted and stunted plants with brightly coloured flowers and berries. Next to climate, as a factor in determining the flora, is *Geology*. A variety in the geological formation is favourable to variety in the vegetable life which it supports; and the botanical richness of Strathpeffer, as of some parts of Kent, may be partly attributable to this circumstance.

Among the more favoured haunts around the Spa may be mentioned the woods of Brahan and of the Cat's Back; Tor Achilty (where the conglomerate formation ceases towards the west); the Craig at Dingwall, also the flat marshy piece of ground close to that town; the Raven's Rock

(especially for ferns) ; Loch Ussie, Loch Kinellan ; Rogie, Scuir Maire, Scuir Vuillin, and Ben Wyvis.

The following list comprises some of the more interesting plants met with in the neighbourhood¹ :—

Thalictrum alpinum, * *Meadow Rue* (S.M.)

Anemone nemorosa, *Wood Anemone*.

Ranunculus aquatilis, *hederaceus*, *flammula*, *sceleratus*, *acris*, *repens*, *bulbosus*, *ficaria*.

Caltha palustris, *Marsh Marigold*.

Trollius europæus, *Globe-flower* (G.)

Nymphaea alba, *White Water-lily* (A.)

Fumaria officinalis, *Fumitory*.

Corydalis claviculata.

Nasturtium officinale, *Water-cress*.

Eryophila verna, *Vernal Whitlow-grass*.

Viola palustris, *Bog Violet* (S.V.)

Polygala vulgaris, *Milk-wort*.

¹ The letters in parentheses following the names signify the habitat, as under :—

C.U. Craig Ulladaile.

K.F. Knock Farril.

C.L. Castle Leod.

Kin. Kinellan.

C. Coul.

Con. Contin.

R. Rogie.

A. Achilty.

Br. Brahan.

G. Garve.

S.M. Scuir Maire.

S.V. Scuir Vuillin.

B.W. Ben Wyvis.

D. Dingwall.

Kil. Kilmorack.

The author cannot himself vouch for all the species marked with an asterisk (*), and would be grateful for specimens of any of them. His thanks are due to Rev. William Macpherson, Dr. R. H. Fox, Mrs. Sprague, and Miss P. Sellon for their valued assistance.

- Silene maritima*, *Sea-campion* (D.)
Lychnis flos-eueuli and *vespertina*, *Ragged-robin* and *Campion*.
Stellaria glauca, *uliginosa*, and *holostea*, *Stitch-words* (Kin.)
Sagina subulata, *Pearl-wort*.
Spergula arvensis, *Spurrey*.
Montia fontana, *Blinks* (Kin.)
Hypericum pulehrum, *St. John's-wort*.
Linum catharticum, *Purging-flax*.
Oxalis acetosella, *Sorrel*.
Genista anglica, *Needle-furze*.
Lotus corniculatus, *Bird's-foot trefoil*.
Astragalus glycyphyllos, * *Milk-vetch* (D.)
Lathyrus pratensis, *Everlasting-pea*.
Prunus padus and *avium*, *Bird-cherry* and *Gean*.
Spiræa ulmaria, *Meadow-sweet*, and *salicifolia*, * *Drop-wort*.
Rubus Chamæmorus, *Cloud-berry* (B.W. and S.V.)
Geum rivale, *Avens* (Kin.)
Alchemilla vulgaris and *alpina*, *Lady's-mantle* (S.M.)
Saxifraga oppositifolia * (B.W.), *stellaris* (S.V.), *aizoides* (C.U.)
granulata (Kil.)
Parnassia palustris, *Grass of Parnassus*.
Drosera rotundifolia and *anglica*, *Sun-dews* (C.U.)
Hippuris vulgaris, *Mare's-tail* (K.)
Epilobium angustifolium, *parviflorum*, and *palustre*, *Willow-herbs*.
Circæa alpina * (S.M.)
Sanicula europæa, *Sanicle*.
Cornus suecica * (S.M.)
Viburnum opulus, *Guellder-rose*.
Adoxa mosehatellina, *Mosehatel*.
Linnæa Borealis * (Br.)
Valeriana officinalis, *All-heal*.
Centaurea cyanus, *Corn-flower*.
Eupatorium canuabinum, *Hemp-agrimony* (D.)
Aster tripolium (D.)
Solidago virgaurea, *Golden-rod*.
Achillea ptarmica, *Sneeze-wort*.

- Chrysanthemum segetum* and *leucanthemum*, *Corn-marigold* and
Ox-eye Daisy.
Tanacetum vulgare, *Tansy* (Fodderty).
Artemisia vulgaris, * *Wormwood*.
Gnaphalium norvegicum, *Cudweed*.
Autennaria dioica, *Cat's-foot*.
Hypochaeris radicata, *Cat's-car*.
Hieracium pilosella, *nigrescens* (Br.), *Lawsoni* (K.F.), and
sylvaticum, *Hawk-weeds*.
Lobelia Dortmanna (A., G., etc.)
Campanula rotundifolia, *Hare-bell*, *latifolia*, *rapunculoides*, * and
Trachelium.
Vaccinium myrtillus and *vitis-idaea*, *Whortle-* and *Cow-berry*
(K.F. etc.)
Arctostaphylos uva-ursi and *alpina* * (S.M.), *Bear-berry*.
Erica tetralix and *cinerea*, *Cross-leaved* and *Common Heath*.
Calluna vulgaris, *Ling*.
Loiseleuria procumbens * (B.W.)
Pyrola media, *rotundifolia*, * and *uniflora* * (C.) *Winter-greens*.
Gentiana campestris, *Field-gentian*.
Menyanthes trifoliata. *Bog-bean* (Kin.)
Anchusa sempervirens, *Alkanet* (D.)
Lithospermum, *Gromwell* (D.)
Myosotis palustris and *lingulata*.
Mimulus luteus (Con.)
Veronica Buxbanmii, *hederifolia*, *arvensis* (Br.), *serpyllifolia*,
officinalis, *Chamædrys*, and *becca-bunga*.
Pedicularis palustris and *sylvatica*, *Louse-worts*.
Lathræa squamaria, *Tooth-wort*.
Mentha arvensis, *Mint*.
Nepeta glechoma, *Ground Ivy*.
Scutellaria gallericulata, *Skull-cap*.
Stachys sylvatica, *Wound-wort*.
Galeopsis tetrahit, *Hemp-nettle*.
Lamium galeobdolon, *Yellow Archangel* (D.)
Teucrium scorodonia, *Wood-sage*.
Ajuga reptans and *pyramidalis*, * *Bugle*.

- Pinguicula vulgaris* and *lusitanea* (R.), *Butterworts*.
Utricularia minor (Kinellan Loch).
Lysimachia nemorum, *Loose-strife*. —
Trientalis europæa, *Chickweed Winter-green*.
Glaux maritima, *Sea Milk-wort* (D.)
Anagallis tenella, * *Bog Pimpernel*.
Armeria vulgaris, *Sea-pink* (D.)
Euphorbia helioscopia, *Sun-spurge*.
Betula alba and *nana* (S.M. and B.W.), *Common and Dwarf Birch*.
Myrica Gale, *Bog-myrtle*.
Juniperus communis, *Juniper*.
Orehis masenla, *latifolia*, *maculata*, and *morio*, * *Purple*, *Marsh*,
Spotted-, and *Green-winged Orchis*.
Gymnadenia Conopsea, *Fragrant Orchis*.
Habenaria bifolia and *viridis*, *Butterfly* and *Frog Orchis*.
Listera ovata and *cordata*, *Tway-blades*.
Goodyera repens. *
Spiranthes autumnalis, *Lady's-tresses* (Br.)
Malaxis paludosa, * *Bog-orchis* (C.L.)
Corallorhiza innata, * *Coral-root*.
Iris pseudacorns, *Yellow Flag*.
Alisma plantago, *Water Plantain* (Kin.)
Triglochin maritimum (D.)
Potamogeton natans (Kin. etc.)
Scilla nutans, *Wild Hyacinth* (C.U., etc.)
Narthecium ossifragum, *Bog Asphodel*.
Sparganium ramosum, *Bur-reed*.
Eriophorum, *Cotton-grass*.
Alopecurus alpinus, * *Fox-tail grass* (B.W.)

Also the following Ferns and Club-mosses:—

- Pteris aquilina*, *Bracken*.
Cryptogramme crispa, * *Parsley Fern*.
Lomaria spicant, *Hard-fern*.
Asplenium trichomanes, *viride*, *Adiantum-nigrum*, and *Filix-femina*, *Maidenhair Spleen-worts* and *Lady Fern*.

- Cystopteris fragilis*, * *Bladder Fern* (D.)
Aspidium lonchitis and *aculeatum* (Raven's Rock).
Nephrodium Filix-mas, *Male-fern*; *dilatatum* and *oreopteris*, *
Sweet Mountain Fern (Cat's Back).
Polypodium vulgare, *Phegopteris*, and *Dryopteris*, the *Polypody*,
Beech, and *Oak Ferns* (R., etc.)
Botrychium lunaria, *Moon-wort* (K.F., C.L., etc.)
Lycopodium clavatum (B.W., etc.), *alpinum* (C.U.), and *inundatum* * (C.), the *Stag's-horn* and *Alpine Club-moss*.

Most of the *Orchids* flourish in the woods around the base of Cnoc Moir (the Cat's Back), especially on the side towards Brahan. The various *Ferns* may be best found at the Raven's Rock, at Rogie and Garve, and at the Craig near Dingwall. *Mosses* and *Lichens* abound in great variety in the stony and peaty hollows of the hills. Those who are interested in the *Fungi* will notice the scarlet *Amanita muscaria* and many other beautiful species in the pine woods. They appear in all their splendour in September and October, when the blossoms of the hills and hedgerows have departed.

CHAPTER X

ANTIQUITIES—THE VITRIFIED FORT

THE district of Strathpeffer is rich in ancient remains. The outline of a *stone circle* may be seen on the roadside near Loch Achilty. There is a central mound, probably once the scene of some religious rites, surrounded by a deep ditch, evidently at one time filled with water from the Loch. In the Moy Wood, south-west of the Cat's Back Hill, may be found a rounded elevation, or *barrow*, which no doubt marks some ancient burial-place. On the summit is a group of *standing stones*, without marks, rudely arranged in two adjacent circles. There is a similar mound, also crowned by large standing stones, near the boundary of the Cromarty and Tulloch estates, on the heights of Brae, between Strathpeffer and

Dingwall. In the folk-lore of the "heights," the barrow on Brae is connected with weird scenes. It is among the stones on its summit that the De'il gathers his family on great occasions, whilst on a neighbouring hillock it is averred that the fairies dance at Hallowe'en.

On the Millbuie in the Black Isle, within easy driving distance of Strathpeffer, there are numerous *cairns* and *tumuli*, particularly a group with a fine stone circle above Kilcoy Castle, and others near the Free Church of Ferintosh. There are also, on the mainland, another circle a little to the east of Alness; a single stone on the seashore between Alness and Invergordon; a beautifully-sculptured stone in the grounds of Invergordon Castle; and others in the churchyard at Fearn and at Nigg. One of the finest circles in Scotland is to be seen at Callernish in the island of Lewis.

The *Eaglestone*, or "Turning Stone" (*Clach-an-tionndadh*), is represented on the title-page. It is said to mark the spot where "the battle turned" in an old clan feud. The tradition is that the Lady of Seaforth (Mackenzie) dwelt in a wicker house on the island in Loch Kinellan.

The Munroes of Fowlis carried off house and lady in her lord's absence, but were overtaken and defeated by the Mackenzies where the Eaglestone now stands.

The *Sun-arch* (horse-shoe) and the *Eagle* both represent Thor in the Scandinavian mythology. It is probable that the symbols of this mythology were communicated to the north of Scotland at a very early date. "The religion of the Picts at the time of Columba's mission consisted chiefly, if not entirely, in the worship of the elements—sun, moon, earth, air, lightning, winds, waters of clear springs, and rivers."¹ Pictish symbols embody ideas connected with the worship of the elemental powers. Pillar stones of the character of the Eaglestone are sometimes referred to about the fifth century.

At Drummond, near Fowlis, a barrow was explored in 1888, and remains of great interest discovered. In two places were found rude *cists* or vaults, between three and four feet in length and about two feet in depth, built and

¹ See *The Origin of Pictish Symbolism*, by the Earl of Southesk.

covered with rough stone slabs. In each cist there was found a skeleton, one of them a woman's,¹ and in addition an urn, decorated with herring-bone ornamentation, together with the remains of a bronze pin. Similar prehistoric graves were

¹ A spectator of the discovery has thus woven a poetic legend of this old-time burial :—

“ With twenty buried centuries,
Or twice as much, 'neath circled mound
The skeleton in darkness lies,
Peaceful in the inviolate ground.

“ A woman's bones, of slender grace,
Perhaps a Queen's, for whom they made
In tears this hilly burial-place,
And in rude vault her body laid.

“ Her head upon her hand at rest,
Her face toward the eastern sea
Waiting the Dawn—the new, old quest
Of night-o'erta'en humanity !

“ Now the sped Spirit drinks the Light—
As once her golden flowing hair
The Sun,—and in that radiance bright
Perchance She is, as then, most fair !

“ Yet still our Thought, which may not bide
In Time's enclosures, joys to rove
Backward as now—The country side,
Clothed with primæval oaken grove,

“ Thee homage and thy table food,
Fair Queen, with plenty, doth endow,
And in the midst a life of Good
And simple Faith and Honour Thon !

“ Could but thy relics speak of thee !
We only know thy race was run,
And that beside the eternal sea
They laid thee t'ward the rising sun.”

opened at Dalmore, near Alness, in 1878. They contained, besides skeletons, rude cinerary urns, flint implements, bronze pins, and, what is particularly interesting, one of them a bead necklace of albertite (*vide* Geology). Barrows, or tumuli, of the same appearance are to be seen on the side of Ben Wyvis and in the Bealloch Mohr, or great pass. It is important to remember that not all structures of this kind are equally ancient. This arises from the habit already alluded to of casting a stone upon a well-known grave.

The ancient burial-place of the house of Cromarty is at Dingwall, and is unmistakable with its leaning monument. At *Press Marce* on the Coul estate there are some curious *cupped stones*. The same sort of markings may be seen at the gate of Kinnahaird Farm and elsewhere. Perhaps the most remarkable cupped stone in the district is the face or slab of rock at the side of the path on the ascent of Ben Wyvis about a mile above the railway. This stone exhibits nearly a hundred cup-markings, some of them double. It is almost certain that it was connected with some superstitious rites, some lingering traces of which

appear to survive, for in our own time offerings of food have been found laid in these cups. There are, beside Fodderty Church, two standing stones—one of them deeply cupped. Tradition says that these stones were hurled by the Fions from the summit of Knock Farril. They were aimed at the opposing hills, but unfortunately slipped in the hand. The “cup-mark” remains to testify to the size and strength of a Fion’s thumb.

There is another class of remains of an exceedingly interesting kind, which carry the mind to an extremely early date, to an age preceding the use of metals. This is the class of *stone implements* which are frequently found in the district of Strathpeffer. Among them may be named flint arrow-heads, popularly known as “Fairy Darts,” stone spear-heads and axe-heads, hammers and knives, sinking stones, whorls, slinging balls, etc. It is remarkable that in all countries remains of this kind are connected with the supernatural. Many such implements have thus been prized as possessing miraculous curative powers, even by cultivated persons. This may perhaps arise from their intensely human associa-

tions. But here also, all are not equally ancient. In some outlying districts and in the islands it is said that stone implements are still in use, and therefore manufactured from time to time. The most remarkable of these is the *Quern*, or hand-mill, for grinding corn. It consists essentially of two circular stones made to rotate one upon the other. The same form of hand-mill was, according to Julius Cæsar, in use among the Britons in his time, and there is little doubt that it was familiar to the Egyptians in the time of Moses. The still surviving use of the quern in the Hebrides is a relic of a custom, not only most ancient and primitive, but widespread in the world.

Another interesting object of antiquity may be mentioned. Here and there in the glens, and sometimes under peat moss, are found the trunks and stumps of ancient oaks. In a few places, as for example above Loch Luichart, one or two of these trees are still green and flourishing. They are lingering survivals of that ancient "primæval forest," by which a large part of Scotland was at one time covered.

KNOCK FARRIL AND THE VITRIFIED FORT

Strathpeffer is separated from the valley of the Conan by a sharp narrow ridge, running north-east and south-west, and terminating at either extremity in a bluff and almost precipitous hill. At the western end of this ridge, which is popularly known as the *Cat's Back*, is Cnoc Moir (representing the Cat's Head), a wood-covered elevation of 882 feet; whilst at the eastern or seaward end Knock Farril (579 feet) rises abruptly from the low alluvial plain. The summit is nearly a mile and a half from the Spa, and threc and a half from the sea, and situated in a direct line between the two. The pedestrian, ascending behind the Ben Wyvis Hotel, or taking the lower road by the Peffery, traverses the fir-wood on the side of the ridge, and, by an easy ascent, soon reaches the depression or pass which marks the neck of Knock Farril. From this point, which is the point of access, the hill rises steep on all sides and almost vertical along the northern face. Here for a length of about one hundred feet the conglomerate rock of the hill juts out as a bare cliff. These rugged

sides are topped by a nearly level oval, measuring about one hundred and fifty yards in length, by a third as much in breadth. Within this space the grass is ever rich and green;¹ here, in one spot, are the remains of an old well, about which tradition states that when the stone shutting it down is lifted, the water will bubble up and fill the valley. Here also, around the oval, are huge blocks, once a complete line of ramparts, compacted together of half-molten stones.

This is the famous *Vitrified Fort* of Knock Farril, probably the finest specimen of its kind in Scotland. These structures have long been a source of perplexity to the antiquary. The exact mode of their formation in ancient times must

¹ "The summits and sides of those hills, which were occupied by our ancestors as *hill forts*, usually exhibit a far richer herbage than corresponding heights in the neighbourhood, with the mineral soil derived from the same source. It is to be kept in view that these positions of strength were at the same time occupied as *hill folds*, into which, during the threatened or actual invasion of the district by a hostile tribe, the cattle were driven, especially during the night, as to places of safety, and sent out to pasture during the day. And the droppings of these collected herds would, as takes place in analogous cases at present, speedily improve the soil to such an extent as to induce a permanent fertility."—Dr. Fleming, *Zoology of the Bass*.

probably be counted among the perished arts. A careful examination of the semi-fused or vitrified mass shows it to be composed of the elements of the native conglomerate. No doubt a flux, perhaps vegetable ash, was used, and by its aid some of the material has been completely fused, whilst other portions are much less affected. The vitrifying agent was, of course, intense heat. It is still uncertain whether the vitrification extends completely through the enormous masses of the ramparts. The author has had an opportunity of examining a section of the formation where the ground had at one place given way and fallen in (*vide infra*). Underneath were rounded stones and angular fragments, entirely unaffected by heat; a little nearer the surface there were similar stones, but bent and contorted (when softened by heat) from the pressure of neighbouring stones, and in some cases adherent one to another by an incomplete and superficial fusion of their edges. Then above these he found the true vitrification, cellular like pumice, or streaked and glazed like the slag from an iron furnace—the whole formation forcibly suggesting a pie-crust, compacted by heat

and stretched over the loose material underneath. It is, therefore, quite evident that the operation of heat was *from the surface*, and not, as was once supposed, from internal volcanic sources. That wood was employed in the original process seems also certain; for fragments of charcoal have been found embedded in detached blocks.

Among several explanatory theories the most probable one seems to be that the fort was originally constructed in very early times, of *loose stones* only, as a place of defence and refuge. At the same time, the commanding position of the hill, with that of many others in the Highlands, made them well fitted for beacon stations.¹ According to Sir George Mackenzie, after the defeat of the Picts by the Scots in the eighth century, nearly twenty of these stations were in use in the great valley extending from Fort Augustus to Dingwall and Banff. According to this view, then, the use of beacon fires, acting by chance on some favourable combination of stones with flux, would on some occasion have taught

¹ Cnoc Fallerie or Fairilees, Gaelic words, signifying *The Hill of the Watching Fort*.

the secret of vitrification. This discovery the inhabitants would be glad to apply on a larger scale to works of fortification, some of them in places where it is nearly certain beacon fires can never have been used.

The vitrified forts are not peculiar to Scotland. In addition to the numerous Scottish forts, similar remains have been found in Londonderry and Cavan in Ireland, and in various countries of the Continent, but not in England. In Scotland they were of old time known as the fortresses of the Fienne (Fions), and were generally referred to the time of the Vikings. The fort on Knock Farril was first carefully examined and described by Mr. John Williams in 1777. Besides the surrounding walls and various outworks, he found signs of vitrified structures within the oval, namely, "a range of habitations reared against and under the shade of the boundary wall." In his time the ruin must have been in a better state of preservation than at present, for he also describes traces of buildings on the south side outside the wall. These, although beyond the ramparts, were sheltered and sunny, and were probably used for

enclosing cattle. It is to this author that we owe the generally received opinion as to the formation of these fortifications by artificial vitrification. More than a hundred years have failed to supersede either his observations or his theory. Mr. Williams further suggested that Knock Farril might probably be the remains of one of Fingal's chief habitations, possibly the ruins of the veritable Selma, the palace of Fingal, celebrated by Ossian, who possibly himself lived in this district, near the river *Cona* (Conan), of which he sings. As pointing to the use of the fort as a dwelling and place of strength, Williams notices the "vestiges of a remarkable road" going north-westward from the summit, and popularly called "the giant's hunting road," which may be traced for at least three or four miles towards the east side of Ben Wyvis.¹

Some appearances within the ramparts at Knock Farril certainly suggest that the fort may very probably have provided *covered* shelter in the shape of large caverns, roofed over with a crust of

¹ See *An Account of some Remarkable Ancient Ruins*, John Williams, 1777; also *Scotland in Pagan Times*, Dr. Joseph Anderson, 1883.

vitrified stone. Remembering the appearances of the section of surface above referred to, this does not seem a very improbable supposition. Moreover, the ground has sunk deeply in many places, and the smoke of a fire may actually be made to travel underground from one hole to another. The matter needs further investigation, but should this surmise prove correct, the Fort of Knock Farril must indeed have been a masterpiece of defensive art.¹

¹ Hugh Miller thus gives in his *Scenes and Legends of the North of Scotland* the traditionary story of the hill :—"On the summit of Knock Farril are the remains of a vitrified fort which was originally constructed, says tradition, by a gigantic tribe of *Fions*, for the protection of their wives and children when they themselves were engaged in hunting. It chanced in one of their excursions that a mean-spirited little fellow of the party, not much more than fifteen feet in height, was so distanced by his more active brethren, that, leaving them to follow out the chase, he returned home, and throwing himself down, much fatigued, on the side of the eminence, fell fast asleep. Garry, for so the unlucky hunter was called, was no favourite with the women of the tribe ;—he was spiritless and diminutive and ill-tempered ; and as they could make little else of him that they cared for, they converted him into the butt of many a joke and the sport of many a humour. On seeing that he had fallen asleep, they stole out to where he lay, and after fastening his long hair with pegs to the grass, awakened him with their shouts and laughter. He strove to extricate himself, but in vain ; until at length, infuriated by their gibes and the pain of his own exertions, he

wrenched up his head, leaving half his locks behind him, and hurrying after them, set fire to the stronghold into which they had rushed for shelter. The flames rose till they mounted over the roof, and broke out at every slit and opening ; but Garry, unmoved by the shrieks and groans of the sufferers within, held fast the door until all was silent, when he fled into the remote Highlands towards the west. The males of the tribe, who had meanwhile been engaged in hunting on that part of the northern Sutor which bears the name of the Hill of Nigg, alarmed by the vast column of smoke which they saw ascending from their dwelling, came pressing on to the Firth of Cromarty, and leaping across on their hunting-spears, they hurried home. But they arrived to find only a huge pile of embers, fanned by the breeze, and amid which the very stones of the building were sputtering and bubbling with the intense heat, like the contents of a boiling cauldron. Wild with rage and astonishment, and yet collected enough to conclude that none but Garry could be the author of a deed so barbarous, they tracked him into a nameless Highland glen, which has ever since been known as *Glen-Garry*, and there tore him to pieces. And as all the women of the tribe perished in the flames, there was an end, when this forlorn and widowed generation had passed away, to the whole race of the *Fions*."



Part of CROMARTY

Part of NAIRN

English Miles

APPENDIX

I

NOTES ON THE VICINITY

“He looks abroad into the varied field
Of Nature, and, though poor perhaps compared
With those whose mansions glitter in his sight,
Calls the delightful scenery all his own.
His are the mountains, and the valleys his,
And the resplendent rivers. . . .

“Nor rural sights alone, but rural sounds
Exhilarate the spirit and restore
The tone of languid Nature.”

COWPER.

VISITORS to Strathpeffer have a wide choice of shorter and longer foot excursions and drives, suited to every capacity and to all stages of recovery. On the northern side of the valley there is a pathway ascending right and left above the old burial-ground. Taking the right-hand path and skirting the plantation, a pedestrian of very limited powers easily reaches the breezy **Golf Course**, where he will be rewarded by a panoramic view. The left-hand path conduets to the summit of **Kinettas Hill**, where footpaths have been cut among the trees, and rustic seats and a flag-staff

ereected. From this point Lochs Kinellan and Achilty, with a range of western hills, are seen. On the southern side of the valley, which the visitor is recommended to take by preference in the afternoons, there is the high ground behind the Ben Wyvis Hotel, affording a prospect of the mountain of that name, as well as a capital bird's-eye view of the village of Strathpeffer. If inclined for a farther climb, one can go on to the Cat's Back, or Knoek Farril; or, keeping the same level, the walk may be extended above the cottages of Park as far as the **Blackmuir Wood**. At all these points the air is usually more exhilarating than in the valley beneath.

Castle Leod, at one time a residence of the Earls of Cromartie, is situated in a spacious park in close proximity to the Spa on the Dingwall road. The ivy-covered walls and round turrets of this old baronial pile, built by Sir Rorie M'Kenzie,¹ are a prominent feature in our bird's-eye view of the valley just noted. There are some fine trees in the park,

¹ "While yet a young man, Sir Rorie obtained from his father the lands of Culteleod, in the parish of Fodderty. After obtaining these lands Sir Rorie had the territorial designation of Culteleod; and the Castle, which he subsequently erected there, in the year 1616, was one of his favourite residences. Culteleod includes within its bounds the lofty Ben Wyvis, the highest mountain in Ross, with its fabulous tenure of rendering to the crown a snowball at midsummer; as well as the beautiful valley of Strathpeffer, now crowded in the summer and autumn months with visitors, for its Spa and its salubrity."—William Fraser, *The Earls of Cromartie* (1876).

in particular some Wellingtonias, and a Spanish chestnut, said to be the largest in Great Britain, with a girth of 26 feet at the base, and 19 feet breast high. Visitors are permitted the privilege of walking in the park before 9 A.M., as far as the iron fence south of the Castle.

Beyond Castle Leod lies the little village of **Auchterneed**. Portions of this hamlet, with the crofts upon the heights above, were allotted to the veterans who returned from the great American War—the survivors of a much larger number who, in the arbitrary manner of the times, were taken for military service from this estate.

Above Auchterneed the Dingwall and Skye Railway mounts the hill westward by a steep gradient. A mile and a half west of Auchterneed station the line passes under the shadow of the **Raven Rock** (Creagen Fiothatch, "Rock of the Raven" or "Echoing Rock"). This precipitous cliff or rock runs almost vertical to a height of 250 feet. It was no doubt thrown into its present form by a fault in the geological formation, and extraordinary contortions of the strata can be readily traced on its northern face. Near at hand rises the Saint's Well or Strathpeffer Chalybeate Spring. A fine echo may be obtained off the rock from the hill above the railway.

The pedestrian in quest of fine view and bracing air may vary his direction above Auchterneed station. He may either cross the burn and follow the footpath on to the shoulders of Ben Wyvis, where he will

probably come across the old Cupped Stone, and see traces of the Strathpeffer Water Supply and Peat Fields; or, keeping to the right above the railway, follow the course of the country road along the "**Heights.**" If he has a relish for Folk Lore—quaint records of an unremembered past—here is a good field for his investigations. Farther on, at the March of Tulloch, are the "standing stones" of which mention is made in the chapter on Antiquities. This entire hillside basks in sunshine, even in the colder months, when the valley is too often in shade. This advantage it enjoys from the circumstance that it is high enough to overlook the ridge of Knock Farril on the south. As, moreover, the ground is sheltered by higher slopes and some plantation on the north, it is admirably suited for winter quarters. It is therefore to be hoped that accommodation will be provided near the railway station on the lower heights, where winter visitants may avail themselves of the bright sunshine, pure dry air, and proximity of the tonic Chalybeate Springs.

The Cat's Back (Druim Chat) is a narrow ridge bounding the valley of Strathpeffer on the south, and runs from Knock Farril south-westward to the bluff summit Cnoc Moir. This summit is easiest of ascent if one first gains the ridge at the depression between the two hills. The walk along the crest between this point and Cnoc Moir affords a magnificent view, not only of the Strathpeffer valley, the picturesque "heights" above Auehterneed, covered with their patchwork of crofts and crowned by the lofty

mass of Ben Wyvis; but also, on the south, Loch Ussie where Kenneth Ohr cast away his prophetic stone before he died, the policies of Brahan, the wide valley of the Conan, and the Beaully Firth and hills of Inverness-shire beyond.

Perhaps the finest view-point of any in the district (unless that from the "View Rock" can compete with it) is obtained from Cnoc Moir. It embraces a wide sweep of country to the west, range beyond range of hills carrying the eye across that mountainous tract of Ross-shire which intervenes between Strathpeffer and the west coast. These are the summits that do the climate of the Spa such notable service by combing out the excess of water from the rain-laden air currents that pass over them from the Atlantic. If a level plain lay between Cnoc Moir and the west coast, the rainfall of Strathpeffer would be double or treble its present quantity. From Cnoc Moir on a clear day one may see seven or eight lochs and rivers—Loch Ussie and the Beaully Firth to the east; Lochs Kinellan, Achilty, and Garve, with smaller unnamed tarns westward among the nearer hills; and southward of these the Rivers Blackwater and Conan, enclosing the base of the sugarloaf-shaped Tor Achilty, and meeting in confluence in the valley below. To vary the route one may return by a path on the southern side of the hill, winding round the precipitous western extremity, and so by way of the Blackmuir Wood to the Spa. This ascent is not a difficult climb, and may be made with great pleasure either in a forenoon, at

sunset—when the effects are sometimes very lovely, or on a bright moonlight night.

Kinellan Loch and the **View Rock**.—A very pretty walk to Kinellan may be had by taking the footpath through the Kinettas Woods, or one may take the road past the Spa Hotel at the head of the valley. It is unfortunate there is no better carriage access to this charming piece of water, which might also be readily utilised for boating and fishing. Passing along the southern side of the loch, one notices the small island (now become a peninsula by lowering the level of the loch) where once was a place of strength of the Seaforths—a rude house founded on oaken logs—now the haunt of water-fowl and an occasional heron. Beyond Kinellan on the north is the cairn-topped hill Craig Ulladaile, where certain small tarns, jewelled with white water-lilies, nestle in the hollows, and the marshes yield the round-leaved and the rarer long-leaved sundews and butterworts without number.

Mounting the hill at the farther or west end of the loch, one may either strike off across the moor to Rogie Falls, or, crossing the fence and taking the footpath on the left, make one's way through a short belt of plantation to the View Rock. This is only two miles from the Spa, and is usually taken by visitors in an early stage of their progress. The view is certainly a fine one, embracing line beyond line of summits, from Ben Wyvis in the north to the hills of Fairburn in the south. In the foreground are Loch Achilty and Tor Achilty, with Coul House to the left,

and the little village of Contin and the Blackwater below. The geological features of this prospect are referred to in Chapter IX.

From the View Roek, if inclined, one may either take a stretch northward across the hills to the Skye Railway and Raven's Rock, or strike the Blackwater, which is due west, and follow it up to the Falls of Rogie, the latter a charming walk ; or, finally, one may come down on Contin, or across the river at the Achilty Bridge, and ascend Tor Achilty. In the last case the pedestrian must not fail to notice the fine raised beach just above the Achilty Bridge. The conical or sugarloaf shape of **Tor Achilty** is a prominent feature in many a prospect of this region. On the Achilty side the slope is gradual and covered with woods, in which the botanist will find a favoured haunt. From the summit, with its precipitous eastern face of conglomerate rock, the eye overlooks like a map the fertile valley of the Conan.

The Falls of Rogie, on the Blackwater.—These may be reached either by a five-miles' drive through pretty scenery, or a walk of four and a half by Loeh Kinellan and the moor. Just beneath the falls the river is spanned by an airy suspension bridge, from which a good view is obtained. The graceful birches and lichen-covered boulders and the brown waters of the river—magnificent in spate—are the chief beauties of Rogie. Visitors often picnic here, and watch the salmon at their instinctive efforts after higher things, leaping in the falls.

Following the road beyond Rogie (the old coach route to the west coast) very charming views of the winding Blackwater are obtained. Four miles beyond the falls is **Loch Garve**, along the edge of which the carriage road and railway together wend. With timid horses it is therefore desirable to watch the time of trains. On the farther side of the loch is situated Strathgarve House. Following the road or railway, the next station beyond Garve is Loch Luichart, also in exquisite birchen scenery. Overlooking this loch, where the osprey and the eagle in their seasons may be seen, is Loch Luichart Lodge, with its charming towers and terraces half hidden in the trees. In the forests above, the deer (red and roe and fallow) abound, and in winter come down to the low ground and even to the houses in search of food.

Leaving the Rogie road at the Achilty Inn, a very beautiful drive is along the side of **Loch Achilty** to Little Seatwell and the **Falls of Conan** (nine miles from the Spa). The former is said to be in point of beauty the most remarkable piece of water in the district. The hills are wooded to the water's edge as at Grasmere. A writer at the end of last century points out "no visible running water issues from this loch," which "certainly discharges itself by subterranean passages" into the river. He also speaks of an artificial island (as at Kinellan), a place made for safety, "where the ruins of a house and garden are still to be seen."

The road undulates beyond Achilty, passing the

Lily Loch, famous for its water-borne blooms, and winding amid woods and rocks to the riverside at Little Scatwell. Here carriages wait, while the excursion (another mile) to the Falls of Conan is completed on foot. A short additional walk brings one to the end of Loch Luichart, and from this point the ascent (1900 feet) may be made of Scur Mair, a good botanical habitat. The route can be varied by crossing the new bridge below Little Scatwell, and taking the Strath Conan road. In this stream rather fine pearls are obtained.

Yet other "falls," to which driving excursions are often made, are the **Falls of Orrin** (nine miles by road) on the estate of Fairburn. The route is by the village of Contin, and crosses the Conan by the Moy Bridge. The falls are situated on the left of the carriage drive about a quarter of a mile within the lodge gates. The rocky bed of the Orrin is here conglomerate, and curiously water-worn. The stream rushes through a very narrow channel, plunging into a deep pool beneath. There are some deep circular holes in the rock, worn (as at the Falls of the Beuly River at Kilmorack) by the continual action of loose stones. The drive past the house, which is permitted on certain days, affords an uncommonly fine view. The ancient Tower or Castle-keep of Fairburn, on the right-hand side of the drive, will attract the attention of the antiquarian. It is reached by a foot-path through the wood nearly opposite the falls. The Spa invalid also may be interested to learn that

in the woods beyond the house sulphur springs have been discovered, similar to, although much weaker than, the waters of Strathpeffer.

Scatwell, the Meig, and Strath Conan.—Only first-rate pedestrian powers, or a pair of good horses, can comfortably accomplish this distance from the Spa; but for natural grandeur of scenery the drive is perhaps unsurpassed in the country. Crossing the Conan by the new bridge at Scatwell, the road slowly mounts with the river. Above Scatwell House, sheltered by its tall pines, the road climbs a long steep hill, and now the wilder and more typical scenery of Strath Conan commences. The road follows the course of the Meig. In winter a torrent, this stream is thrown into a series of cataracts tumbling down the bottom of a deep gorge. From the brink of the chasm one can gain a glimpse of the waters, more than two hundred feet below. This extraordinary gorge is about a mile in length, and from it the troubled waters flow forth to join the sister stream from the Loch Luichart at Little Scatwell in the plain below. Eight miles farther on, at the very head of the Strath, is Strath Conan Lodge with its extensive deer forest. The scenery is very fine about Seardroy above the Lodge, and in these hilly haunts the golden eagle may still be seen.

Brahan Castle.—A favourite circular drive is by way of Contin to Brahan Castle, returning through the village of Maryburgh and Dingwall to the valley of Strathpeffer. The carriage road from Contin

follows the Conan, passes the Moy Bridge (the route to Orrin and Fairburn, Scatwell and Strath Conan), and divides about a mile short of the Castle. Here a monument marks the spot where the sister of the Honourable Mrs. Stewart Mackenzie met with a fatal earriage accident. This event was regarded in the country-side as the fulfilment of one of the prophecies of the Brahan Seer (Coinneach Odhar).¹ The right-hand road conduets to the castle, whilst the road to the left, mounting a little, skirts the beautiful woods of Brahan. Fragments have fallen from the cliffs above, and, covered with moss and ferns, form a magnificent natural rockery. Here the botanist will love to linger, for "the world is all before him where to choose"—from the crevices of the Brahan Cliffs to the reedy margins of Loch Ussie. The Castle is a massive square building, and was once strongly fortified. It contains some fine works of art. The flower gardens are beautifully laid out from the design of Sir Joseph Paxton.

Ben Wyvis.—The ascent of the Ben (3429 feet) is usually made by way of the village and "heights" of Achterneed, but may be made by Garve. The former route follows for some distance the line of the Strathpeffer Water Supply. About a mile above the railway on the right-hand side of the path is the

¹ Those interested in Highland superstitions should read whilst at Strathpeffer *The Prophecies of the Brahan Seer* by Mr. Alexander MacKenzie of the *Celtic Magazine*. Many of these predictions refer to the immediate neighbourhood of the Spa.

curious *Cupped Stone*, partly overgrown by heather, and bearing a large number of circular and ring-like depressions. Near the summit is the remarkable Corie-na-Feol, or Flesh Corrie, so called from the number of deer killed by falling over its precipitous sides. The view from the cairn is very wide, and includes, it is said, portions of eight counties. The Cromarty and Moray Firths are well seen, almost in the foreground of the prospect, and on fine days glimpses may be had of the sister mountain, Ben Nevis.

Falls of Kilmorack and the Beaully River.—In his interesting *Manual of Strathpeffer Spa*, Dr. Manson writes :—"On the plain of the Muir of Ord are two upright stone pillars, commemorative of some feat of ancient warfare. The Falls of Kilmorack lie west from Beaully, and are reached by way of Beaully Bridge. They are situated immediately underneath the parish church of Kilmorack, and are less remarkable for their height than their breadth and quantity of water, and for the accompaniments of lofty rocks, smooth green banks, and hanging woods which encircle them. The river, dashing from between two lofty precipices, where it is confined to an extremely narrow channel, suddenly expands into an open semicircular basin, through which it slowly glides, and is then precipitated over its lower edge in a series of small cataracts. Below the falls on the right bank of the stream Beaufort Castle is seen to great advantage. A fine view may be

had from a bridge across the river, two or three hundred yards below the Falls. Another group of waterfalls occurs about three miles farther up the river, at the top of a romantic ride called 'The Drhuim,' which signifies a narrow pass. This is the most typically Highland and beautiful part of the course of the Beaully River. On either hand the mountain acclivities are rather steep and rocky, and the valley between them is not a quarter of a mile broad; but woods of birch and fir encompass the whole scene, especially on the north side, and the edges of the river are fringed with rows of oak, weeping birches, and alders. In one part, half up the Strath, near the cottage of Teanassie (the burn of which will reward the explorer) the waters plunge through a rocky passage encircling high pyramids of stone, standing up in the midst of the stream, gigantic witnesses of its ceaseless and consuming power. On the southern bank, on a high conical mound, rising above a perpendicular sheet of rock, is Dun Fion, a vitrified structure, laid open some years ago for the inspection of the curious.

"At the farther end of the Drhuim, the road begins to ascend towards the interior of the country, and here the river is seen pouring down on each side of a high rounded hill, covered with oak and birch, at the lower extremity of which it forms the second set of small but beautiful cataracts. This is the island of Aigas (for the river parts into two, and encircles it), with a picturesque shooting-lodge,

which was at one time the retreat of the late Sir Robert Peel. An open glen succeeds, with the house of Aigas on the right; on the left the mansion of Eskadale; to the westward, the small hamlet of Wester Eskadale, behind which, though half-concealed by the birch trees, appear the white walls and pinnacles of a Roman Catholic Chapel, where may be seen the tombs of the Chevaliers d'Albany, the 'Sobieski-Stuarts.' Four miles on is Erchless Castle, a stately old tower modernised, the seat of 'The Chisholm.' At Eskadale there is a ferry across the river, of which the pedestrian visitor to the Falls and the Drhuim might avail himself to vary the homeward route to Beaully—returning by a road which runs along the south side of the river. About a mile beyond Erchless are Struy Bridge and Inn. More picturesque scenery than that along the course of the Beaully is rarely to be met with in the Highlands. Time permitting, the ruins of the ancient Cistercian Priory of Beaully, founded A.D. 1230 by John Bisset of Lovat, might be inspected.

“On the course of the Glass (the continuation upwards of the Beaully), and between Fasnakyle Bridge (ten miles above Struy) and Loch Benneveian (five miles farther on), is 'The Chisholm's Pass,' the scenery of which is somewhat similar to the celebrated birken bowers of Killiecrankie and the Trossachs, but on a much ampler and grander scale. In ascending the shelving opening (by the road on the north side of the stream), a prolonged vista, in one general mantle

of foliage, rising high on either side, forms a woodland picture of incomparable beauty, threaded by the rocky channel of the river. The road, on the south side of the stream, from Fasnakyle Bridge to Guisachan, the picturesque Highland residence of Lord Tweedmouth, runs within a mile of the pass on the right.

“The Black Rock.—A very extraordinary and interesting natural curiosity, and one well worthy of a visit, is what is called ‘The Blaek Rock,’ a frightful chasm, occurring in a thick level bed of conglomerate near Evantown on the Cromarty Firth. It is twelve miles from the Spa, and may either be driven to all the way, or train may be taken to Novar Station. If a carriage be taken, the drive along the margin of the Cromarty Firth will be much enjoyed. A branch road, striking off northwards from the main road, just beyond Evantown, brings us in a mile near to the chasm. Only eight feet wide, and in many places arched over by intermingling branches of trees from the opposite sides, it is about 100 feet in depth, and two miles in length. At its bottom, the waters of the Aultgraat, visible only here and there from the bank above, rush and tumble in subterranean gloom. A footpath along the wooded bank conducts, a mile and a quarter upwards, to a wooden bridge over the chasm, from which an open view of its profundity may be obtained. The Aultgraat issues from Loch Glass, about three miles above the chasm, and forms, after quitting the

loch, a series of highly picturesque falls. Loch Glass lies at the base of Ben Wyvis. The chasm is evidently the result of the action of the water on the rock, mostly, perhaps, at a time when the conglomerate was in a less compact state than now.”¹

¹ In the North such places of course have their legends. See Hugh Miller's *Scenes and Legends of the North of Scotland*, p. 171; also *Rambles of a Geologist*, p. 335. The son of this distinguished man, the late Mr. Hugh Miller of H.M. Geological Survey, has added considerably to our knowledge of the geology of this district. Referring to the Black Rock he writes (to the Inverness Scientific Society):—"You will observe the proofs of aqueous action by means of potholes, as of a kind of gigantic mill from end to end. The remains of the potholes are visible in the form of segments of smooth bowls from a few feet below the brink all the way down the water. The lesson is the more impressive because the joints of the exceedingly massive conglomerate in which the gorge is scooped are, with a single exception, oblique to the direction of the gorge. The one exception is to be seen from the foot-bridge looking down the stream; notice the large pebble-shaped recess where the stream leaves this straight and mural line. The gorge by my measurement is just 97 feet deep from the edge to the surface of the water at its maximum depth; that is near the great boulder which bears the traditionary marks of the Lady of Baleonie's keys. Its minimum width is about 12 feet. At the foot-bridge it is 70 feet deep to the water, and 40 feet wide."

An examination of the gorge was made in 1889 by the Inverness Society under the guidance of Mr. Horne (also of the Geological Survey), and the conclusion was arrived at that the cut was made since the glacial epoch. Asked how long since that epoch closed, Mr. Horne said that if the theory advanced by Mr. Croll was accepted, then it lay within a period from 80,000 to 160,000 years ago. There was a pre-glacial valley or gorge, the entrance to which is discernible on the south side of the present gorge a

Cromarty and the Black Isle.—At Invergordon, three miles beyond Alness, there is a ferry to the Cromarty side of the Firth. This is the route for visiting the native place of Hugh Miller; and the visitor to Cromarty should make a point of seeing the great geologist's museum. The Black Isle railway from the Muir of Ord gives access to this region from the south. The country possesses within narrow limits much historial and archæological interest, and with improvement in accommodation is likely to become increasingly attractive to visitors. Both Cromarty and Fortrose, with Rosemarkie, are quite likely to develop into pleasant sea-side resorts. Cromarty is at present rather difficult of access, but few places, in the writer's opinion, are so well suited for an "after-cure" on leaving Strathpeffer.¹

Dunrobin Castle, the residence of the Duke of

short distance above the foot-bridge. "You will see," wrote Mr. Miller, "that the boulder clay tends to slough out from this drift-filled valley into the wider strath above, which, with its alluvial alder-fringed flats and slipping grassy scars, you will recognise as entirely pre-glacial. From a good position an eye well practised in these matters can see the two notches or slits side by side, but it is not at all so distinct as I have seen it in other valleys, and the south wall of the pre-glacial gorge is obscured by the drift. Whether it went over to the neighbouring pre-glacial valley of the Skiaeh burn, or found its way to the pre-glacial hollow, which, from the large boulder-clay scars below the Black Rock, you infer to exist there, it is impossible to say." See Chapter IX., "Geology."

¹ See *Illustrated Guide to the Black Isle Railway*, by A. J. Beaton, Esq.

Sutherland, and **Thurso** and **John O'Groats** in the extreme north ; **Inverness** and **Culloden**, the scene of the last battle on British soil, and **Nairn**, with its bracing air and fine golf-course ; **Loch Maree** and **Gairloch**, **Balmaearra**, and the **Western Islands**, are all readily accessible from Strathpeffer by the Highland Railway.

II

THE MEMORIAL OF COLIN MACKENZIE

“THE Memorial and Representation of Colin Mackenzie, Factor upon the Annexed Estate of Cromarty, humbly sheweth :

“That some years ago a fine Mineral Well was discovered on the Lands of Ardival, in the Barony of Strathpeffer, a part of the said Annexed Estate of Cromarty ; and some of the country-people having, partly from curiosity and partly on account of some disorders they laboured under, continued to drink this water, it totally removed the complaints of such as were ailing. This circumstance drew the attention of several of the better sort of people to this Well ; and Dr. Alexander Mackenzie, at New Tarbet, having made some experiments upon the water, sent some of it to Dr. Donald Munro, at London, who, after making the proper trial, wrote a short treatise upon its qualities, which he gave into, and which stands recorded among, the *Transactions of the Royal Society*, and in which treatise it is said that by adding a little salts to this water, it is at least equal, if not superior, to that of Harrogate.

“From almost daily and repeated instances, it is certain beyond doubt that this water creates an appetite and digestion, and is a remarkable cure for scorbutic or other disorders in the blood, swellings, ulcers, etc. And the memorialist knows of two instances—one of William Smith, Master of the Grammar School of Fortrose; and the other of Angus Sutherland, tacksman, of Kincardine—who were both so lame and feeble that they were obliged to be carried to the Well on feather beds in carts; but by the use of the water for some weeks they so far recovered as to be able to walk upon their own legs for miles. From these and (the following) other favourable circumstances, the Strathpeffer Well has for these five years past been pretty much frequented by different ranks of people from the counties of Ross, Cromarty, Inverness, Moray, and Sutherland; and last season there were some from the town of Aberdeen.

“But the want of accommodation near the Well for the better sort of people discourages many from coming there that otherwise would attend. The memorialist therefore humbly submits to the Honourable Board whether it would not be proper, for the encouragement of ladies and gentlemen resorting to this Well, to build a good House, Kitchen, and Stable—either upon the Farm of Kinettas, or upon the Lands of Ardguaie, both of them dry, wholesome, well-aired places, commanding a fine prospect, and lying within a gunshot of the Well, abounding

with agreeable and romantic walks, and having very fine goat pasture within half a quarter of a mile of them.

“This house would not only be a great accommodation to those frequenting the Well, but would be of great use to the tenants of the whole Barony of Strathpeffer. It would be the means of affording them a ready and good market during the summer and harvest seasons for what wares they have to dispose of; such as butter, cheese, eggs, milk, kid, lamb, mutton, and poultry; and would in general create such a circulation as to enable them to pay their rents more punctually than usual, and also to rear more of the above articles than they formerly did. Nor is it improbable that in time this place might become a thriving village.¹

“The minister of the parish caused to be erected a kind of building about this Well to preserve it from being abused by cattle, etc., which by no means answers the end proposed. But by laying out an expense of £5 or £6, a proper building might be erected that would preserve the Well from any abuse either from man or beast.

“It is of infinite service to numbers in this part of the world; and I wish to God half a dozen of the Honourable Board (for pleasure only) tried it for three weeks—they would get an appetite, a pack of good hounds, and plenty of game, goat whey, etc.

¹ The date of Mr. Mackenzie's Memorial is 1777. Time has abundantly fulfilled the prediction of the far-seeing Factor.

Then there would be little occasion for soliciting a support to the enclosed Memorial Representation. However, lame as it is, and far short of what might have been said by a proper hand for writing upon that subject, I beg to have the opinion of the Board upon it."

III

DR. THOMAS MORRISON'S DIRECTIONS TO THE LADIES AND GENTLEMEN FREQUENTING STRATHPEFFER SPA.

THE following Directions are dated April 1822, and for a long time hung in the Pump Room for the use of visitors :—

“To the Ladies and Gentlemen attending the Pump Room the few directions which follow will be found of importance in giving full efficacy to the mineral, which, I have no hesitation in saying, exceeds in excellence any water of which Great Britain can boast :—

“*Medicine.*—During a course of any mineral water, it is of most material consequence that the first passages should be in the best possible state. I would therefore recommend, at the commencement of a course of this water, that one of the pills No. 1 should be swallowed every night for ten or twelve days, taking every morning, previous to drinking the mineral, one or two teaspoonfuls of Epsom Salts, according to the effect, in a tumbler of hot water.

It may be observed that during the whole course of drinking the water the bowels ought to be kept in a more easy state than at other times may be deemed necessary, for this purpose No. 2 may be used, one or two taken every night; and the salts, if at all requisite, in the morning. The salts and pills may be alternated, and that adhered to which best agrees. In the event of any liver complaint, or after a long residence in hot climates, the pills No. 1 ought to be persevered in; and in every case recurring to them occasionally for a few days is useful. A teaspoonful of magnesia, taken in a little milk at bedtime, betters the state of the stomach when at all deranged.

“*Diet.*—The diet ought to be entirely confined to tender and animal food, eggs, and rice. Beef, veal, and mutton, lamb or poultry, may be indiscriminately taken, if kept until tender; but no salted meat, hung meat, such as ham or tongue, or salted fish, is at all admissible, excepting salmon and herrings. I do not absolutely prohibit fish, although I give the preference to butcher meat. No vegetables ought to be taken, either raw or boiled—it is better that they should never appear at table. Rice, thoroughly boiled, ought to be a standing dish. Oatmeal in every shape ought to be avoided. As many eggs, boiled rather under than over three minutes, may be eaten as you please. No spirituous liquor, or malt liquor of any description, ought to be used. You may take one glass of wine at dinner, although not necessary. To tea I have no

objections. I prefer it very much to coffee. Butter, if at all taken, must be in very small quantity. Avoid pastry, and never eat anything from the frying-pan.

“Strathpeffer Water.”—Three of the ordinary used tumblers in the morning I deem a sufficient quantity, but I prefer four tumblers in the morning, and a like quantity in the forenoon and only one in the evening—after each glass walking in the open air when the weather permits, and in the Pump Room when it does not. Of course the open air is always to be preferred. The utmost attention ought to be paid to the corking of the bottles when water is carried to any distance—no cork having had a screw through it ought to be used.

“I deem six weeks the shortest space for which any one ought to remain who labours under complaints of the least consequence; for although the water may ameliorate the condition by giving appetite and mending the complexion in a shorter period, the effects most probably will be transitory. Rise early and go early to rest, and let your exercise be regular but moderate.

“Although those who do not comply with the above directions may find benefit from the water, they will not profit by its use in the same degree as if they attended to them. The pills may be procured from the Keeper of the Pump Room, and their accurate preparation may be relied on.

“(Signed) THOS. MORRISON, M.D.”

“Several years having elapsed since the above directions were given, the experience derived from an observation of the leading cases enables me at the present day to recommend them earnestly to the frequenters of the Pump Room. I approve that the chill of the water should be taken off, but I deprecate its being drunk hot.

“*October* 8. — Although a superabundance of acidity in the stomach is more common than a deficiency, the latter is to be suspected when the water has not its usual influence in creating appetite. In such cases a teaspoonful of cream of tartar, taken in any article twice a day, for a week or ten days, ought to be tried.

“(Initialled) T. M.”

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